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ARCHÆOLOGY OF THE CHAMPLAIN VALLEY.

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THE region which surrounds Lake Champlain presents a very great variety in its surface features. As the tourist sails through the lake he may see, here lowlands, there mountains; on the one hand rocky hillsides, on the other meadows or marshes; here boundless forests, there wide and sparsely timbered plains, the whole intersected by numerous large streams and in the midst the lake itself, its northern portion filled with large islands, while south of these is open water. Such a territory must, if we can judge, have offered very great attractions to those savage tribes of red men who, in the early days before the white men began to encroach upon the lands they called their own, roamed through the forests or glided in their canoes over the water, for here they would find hunting grounds occupied by a great variety of game, surrounding fishing grounds of equal richness, fertile fields for the cultivation of the few vegetables which they used, and many a wild retreat in which they could conceal themselves from any powerful foe who should attack and defeat them. In such a region we should expect to discover many a site of an ancient village and great numbers of those stone implements which indicate the former presence of those who made and used them.

We do not, however, find these expectations fully realized, for remains of ancient settlements are very rare, and no sure evidence exists of any long continued occupation of any locality in the immediate vicinity of the lake, and if a considerable population, with fixed settlements, ever lived there, it was long before the advent of the early explorers. In the writings of Champlain and others, we find intimations, in the quoted statements of the sav-

ages, that at one time the shores, especially the eastern, and the large islands of the lake to which he gave his name, were inhabited, but the savage allies of Champlain, who early in the summer of 1609 sailed through it, told him that because of hostilities between the tribes they were not then peopled, and this explorer did not, apparently, see any of the Iroquois who held the region until he reached a place which must, judging from his brief description, have been near what is now Crown Point. At this place, in May 1609, he joined his Algonquin allies in a battle with the Iroquois, and thus inaugurated the long series of conflicts which have made the place historic. Probably, further investigation will disclose some new facts, but at present we know of only two localities very near the lake shore where there are any sure evidences of continued occupation. One of these is on the shore, or very near it, at Plattsburgh, N. Y., the other is further from the lake, on the banks of the Missisquoi, one of the rivers emptying into the lake, near Swanton. Here and there on the large islands, and near the shore, large quantities of flint chips, or an unusual abundance of specimens, arouse a suspicion that there was located at one time a village, but the proof is wanting in all cases, though the probability may be strong. As we should expect from what we know of the condition of the tribes when first visited by white men, we find relics—and of many kinds, and in all a considerable quantity—not often in large numbers in a limited area, but scattered here and there over the country. Near the mouths of some of the larger streams, and along their banks, more are found than elsewhere, and there are some favored localities where diligent collectors have been rewarded with more than ordinary success, but after all, at least so far as Vermont is concerned, the above statement holds true. One of the most interesting localities, and one that probably affords us some of the most ancient specimens, is that already mentioned near Swanton. As a full account of this locality has been published in the Portland Volume of Proceedings of the American Association for the Advancement of Science, where some of the specimens are figured, I need only give here a brief statement of the leading facts respecting it. When Swanton was settled by white men a village of St. Francis Indians was located near the place, and many stone implements used by them have since been found. Probably most of the objects of this sort found on or near the surface should be referred

to this people. But another and more ancient people had also had a settlement near the same place, whose only relics, so far as we know, are such as they buried with their dead. On a sandy ridge near the Missisquoi, about fifteen years ago, an extensive pine forest was partially cut away. The trees, some of which had been growing perhaps for centuries, had hitherto protected the mobile soil from the prevailing winds, but after the clearing the sand was blown away until stone objects and fragments of bone were disclosed. My friend, Mr. H. H. Dean, of Swanton, together with others, thereupon examined the locality and discovered that where the old pine forest had stood, some unknown race had buried their dead, placing in their graves such objects as custom or affection indicated.

Between twenty and thirty graves in all have been discovered. A variety of objects have been taken from them, some of which were found directly beneath the stumps of large trees. These objects differ materially from those which belonged to the Algonquins, being of finer material and more excellent workmanship, and most of them closely resemble similar specimens from the mounds of the Mississippi valley, many being identical. In all cases except two the sand about the bodies was colored a dark red, probably by some mixture of red hematite and water, and some of the stone implements are stained with this same substance. The skeletons in the graves were mostly decomposed, so that only few and fragmentary bones have been preserved. A few objects made of native copper beaten into shape were found, such as chisels, small bars, and beads made of sheet copper rolled into tubes. Shell beads almost precisely like some of those figured by Mr. C. C. Jones in "*Antiquities of Southern Indians*," have been found in considerable number. Of stone implements and ornaments a much greater number were found; of these, perhaps the most interesting are stone tubes, of which about a dozen have been obtained. These are all of similar form, being cylindrical, the perforation, at one end about half an inch in diameter, enlarges to nearly an inch in diameter at the other end. They are of smooth, hard stone, of a drab color in some specimens, brown in others. They are very nicely formed and finished, the surface being smooth and almost polished. The small end of the bore was stopped somewhat imperfectly by a stone plug ground into shape. The length of the tubes varies

from seven inches to thirteen inches. Similar tubes have been found on one of the islands in Lake Champlain and near Burlington, and Mr. S. L. Frey, of Palatine Bridge, N. Y., has described¹ very similar ones from graves at that locality. And in most respects the graves which Mr. Frey has discovered resemble those found in Swanton to a very remarkable degree. Several gorgets, or two-hole stones, some of them made with great skill, have been found in the graves, and other objects which may properly be classed with them, viz: boat-shaped stones and two carved bird-like heads. All of these are made from ornamental stone, and are carefully finished and perforated, at each end of the base in the heads, and each side of the middle in the boat-stones. It is worthy of note how large a proportion of the objects which were buried in these graves are ornamental in their character, or at least of a higher grade than the ordinary axes, spear, arrowpoints and the like. Although specimens of these have been found, they do not occur in large quantities, and they do not, as is usually the case, make up the greater part of the collection.

In North-eastern Vermont there were settlements, formerly of the Coosuck Indians, a branch of the Abenaki, and near what is now called Wells river, remains of a village and fort were visible not many years ago. So far as my observation extends, that portion of Vermont west of the Green mountains was more thickly settled, or perhaps it would be more correct to say more frequently visited than the eastern portion. As all the specimens are obtained in such a manner as to preclude the possibility of fixing even their relative age, this cannot be definitely determined, but I am clearly of the opinion that, while probably a large part of the objects found are to be considered as having been made and used by the Iroquois or Algonquin tribes, there are others of a more elaborate pattern, showing greater skill and taste, which are to be referred to a more ancient and unknown people. I wish to give a general account, necessarily brief and imperfect, of the several kinds of objects found in that part of Vermont and New York which may be properly included in the Champlain valley. Copper articles are rare and all are of, presumably, Lake Superior native copper beaten into the required form. More copper specimens have been found in

¹ AMERICAN NATURALIST, Vol. XIII, p. 637.

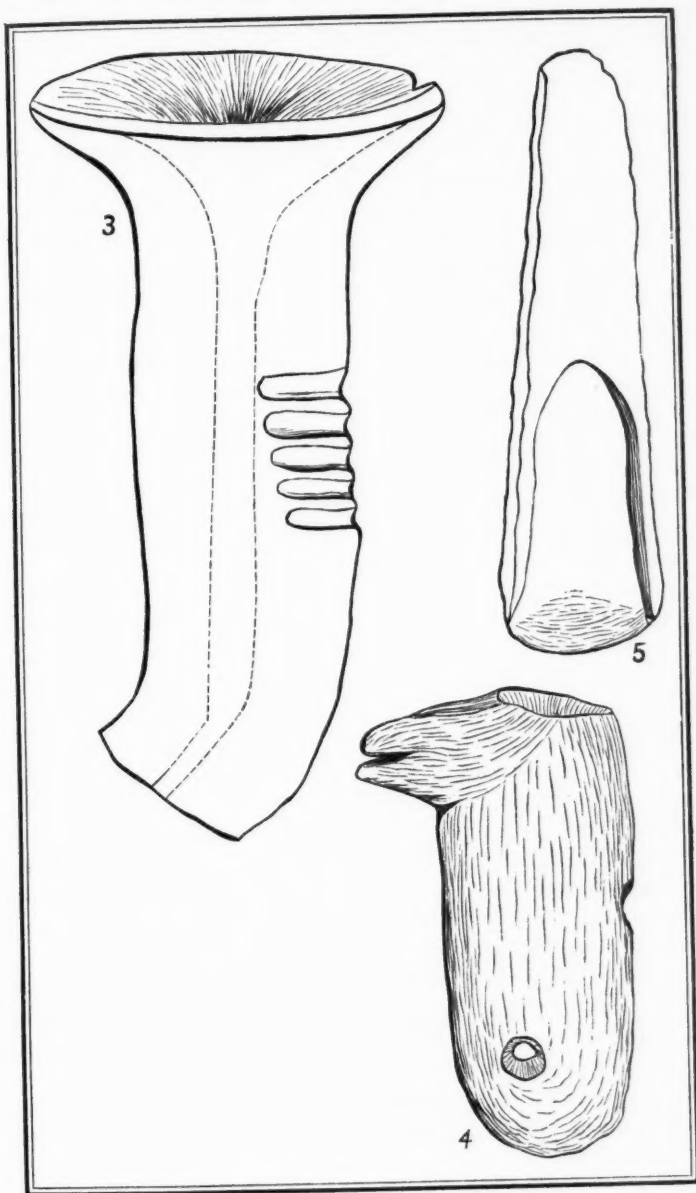


PLATE I. Perkins on the Archæology of Vermont.

the Swanton graves, as incidentally noticed above, than in any other locality, but other articles, one here and another there, have been found in various places. A very fine copper gouge was found near Milton and is in the collection of Mr. P. C. Deming of that place, who has a very fine local collection. This is shown one-half full size in Fig. 5. Spearpoints, occasionally with notched stems or with the sides of the stem turned over to form a socket, also occur sparingly. These, together with the articles already mentioned in connection with the Swanton graves, complete the list of copper articles. No objects made from shell except the shell beads from Swanton have been found.

Specimens of earthenware occur all over the State, chiefly in the form of fragments. The only entire specimens of jars now in existence, are two in the college collection at Burlington. Several others have been found but have been destroyed. Both of the entire jars are figured in Vol v, pp. 14, 15, of the *NATURALIST*, though Fig. 2 is not entirely correct in its representation of the rim. As I have given a detailed account of some of the more prominent kinds of Vermont pottery elsewhere,¹ it must suffice to give here only general statements. All of the earthenware was ornamented somewhat, some but little, some more, the decoration consisting of impressed figures of a great variety of form, as squares, circles, triangles, crescents, key-shaped figures, etc., with lines of greater or less width running either horizontally, obliquely or vertically. These are combined to form a great diversity of patterns. Some of them, as may be seen by a reference to the figures mentioned above, are very elaborate. No decoration by the application of paint or any coloring material occurs. In most cases the ornamentation is confined to a narrow band around the rim, and I believe in all cases the lower portion, which was globular, was smooth. The mouth of the jars was usually circular, but sometimes rectangular, becoming circular at the contracted portion, or neck. In no case was there any attempt at imitation of animal forms. The material of which the jars was made is essentially like that found elsewhere. In some cases it appears to have been gravel mixed with clay, as the fragments of quartz and feldspar are rounded, in other cases the fragments are angular, and were obtained by pounding; fine sand seems to have been used in some cases. In color there is as great

¹ *Proc. A. A. A. S.*, Vol. xxv.

a variety as in texture, some pieces being light stone color, others black and others of intermediate shades. The smallest jars are only known by fragments. From these, so far as we are able to reconstruct the jars, we judge that they held about a pint. The largest jar is one mentioned in Thompson's "Vermont." This was found in Middlebury, and held twenty quarts, but I can not discover what has become of it. The two jars in the museum at Burlington hold, respectively, nine and twenty-four pints. A few fragments of pipes have been found made of terra-cotta. Mr. Deming has, in his collection, a perfect specimen of very fine material of the form which resembles a trumpet, much like some figured by Schoolcraft.¹ The Milton pipe, Fig. 3, is of very fine form, of a reddish-brown color, smooth and polished on the surface. It is about four and a-half inches long, nearly straight except at the smaller end, which is abruptly bent down, and at this point the bore is but an eighth of an inch in diameter, though it is twice as large throughout most of the length, and at the large end, which is two inches in diameter, it expands to nearly the same size. Across the middle portion of this pipe are five transverse grooves, which extend about half way around the body. Dr. Kellogg of Plattsburgh has a fragment of what appears to have been a very similar pipe from the New York shore of the lake, and some of those figured by Schoolcraft were found in that State. In the abstract of a paper read at the St. Louis meeting of the A. A. A. S., and published in Vol. 27 of the "Proceedings," I stated that no agricultural implements had been found in Vermont. Very soon after making this statement I found undoubted implements of that character, and while they are by no means abundant, they are certainly not absent, for I have seen quite a number, nearly all of them spades, although one or two may have been used as hoes. None of the specimens exhibit the regular oval form of western specimens, but all are more or less narrowed at one end, and are generally lanceolate or leaf-shaped. Nor do they equal the best western specimens in regularity of outline and elegance of finish. They are all of flint or hornstone, flaked, and are usually strong though all are not clumsy. The largest are about ten inches long and four inches wide, while the smallest may not be half so large. It is not unlikely that agricultural operations may have been carried on by the aid of other implements than those usually assigned to

¹ History, &c., of Indian Tribes, Part 1, pls. 8 and 10.

that use, and many specimens of celts, ungrooved axes and the like may have served a good purpose as spades or hoes. Some of the specimens found in Vermont, which from their form would be classed as celts, are of soft material and of a character such as to render it very probable that they were used for digging rather than cutting. If this be so, agricultural implements may be more abundant than has been supposed. All the ordinary varieties of axes and hatchets have been found about Lake Champlain, by far the most abundant being celts, or ungrooved axes, and because of their great diversity in size and form, I am led to believe that these implements may have served many different purposes. Indeed it would not seem very improbable that the same implement may have served at one time as a tomahawk, at another as an axe or chisel; or, with a different handle, even as a spade or hoe. Forming a sort of connecting link between the celt and the grooved axe is the notched axe. Most of the specimens of this class are small, but a few quite large ones have been found; most of them are rather rude and of coarse material. Grooved axes are not common, though some few very fine specimens have been found, but I have seen none that would compare favorably with the finest Western specimens either in size or elegance of form. The largest which I have seen is nine inches long and four and a-half inches wide, but most of the grooved axes are much smaller. Such specimens of axes as have been collected have been obtained, one here and one there, singly, nowhere in such groups as some collectors describe. I presume that all the grooved axes ever found in the Champlain valley, unless many were destroyed before collectors began to save them, would not amount to so large a number as Dr. Abbott mentions from a single small excavation made in digging a cellar in Trenton, N. J. Hatchets, chiefly of flint, are found, some of them with very sharp edges and regular form. One very unique specimen of axe, if such it is, should be mentioned here. It is in the possession of Mr. W. W. Culver, of White River Junction, and was found near that place; its form is that of a letter L, somewhat like one figured by Evans¹ which was found in England, but the Vermont specimen is much larger. It is shown about one-fourth natural size in Fig. 6. The longer arm is seven and a-half inches and the shorter four and three-quarters inches long, and both are

¹ Rude Stone Implements, p. 124, figure 82.

about two and a-half inches wide ; it is made from basaltic rock ; one surface is flat, the other convex. The edges are rounded, well made and sharp.

- Specimens of " pestles " are often found, though whether all of them were used as implements for pounding grain seems more than doubtful. In our collection we have three which I should hesitate to call pestles. One of these, especially, seems unfitted for such use, but rather seems to have been made for a baton of office, or a club. It is shown about one-half natural size in Fig. 1 and is twenty-seven inches long, quite slender, and uniformly cylindrical, its average diameter being about two inches. Its weight is six pounds. The diameter is nearly equal throughout; one end is somewhat contracted, and the opposite more so to form a neck for the carved head which terminates it. This carving, though not elaborate, yet distinctly and strongly indicates a head, somewhat dog-like and somewhat fish-like, in some features resembling one animal, in others the other. There are no ears, but the eyes are large and prominent. The muzzle is much elongated, the whole length being over three inches. The mouth is represented by a deep groove extending back on each side as far as the eyes. From the lower lip a raised ridge runs back and over the top of the head, which resembles somewhat the gill-cover of a fish. The material is a gray schist well finished, and where the surface is not weathered it is smooth. This specimen was found near the lake shore not far from St. Albans. Another very similar specimen, but without the carving, has recently been found on the New York shore. Another specimen of this sort, with a somewhat similar carving, though shorter and thicker, is made of hard red sandrock, such as occurs abundantly in this region. This specimen, though of about the same diameter as the preceding, is only half as long, and the diameter is not so uniform, but increases from the carved end to the opposite, which is rounded unevenly. A third and still different specimen was found near Highgate, Vt. This is a little less than twenty inches long and made of fine-grained gneiss. It is not cylindrical, but oval in cross section, the surface being well smoothed, and it appears to have been at first rectangular in cross section and made oval by rounding the corners. The surface was first picked and then ground so that most of the marks of the pick are removed. The carved end represents, rather rudely but yet

plainly, the head of a squirrel or some similar animal. All of the above carvings are somewhat oblique with reference to the main shaft of the specimens. I have heard of a similar "pestle" with carved end in the State collection at Albany, but I have not seen it. May it not be that these articles were either clubs or for some similar use, the carving indicating the totem of the owner?

Of the more common forms of "pestles," we have found in Vermont, I believe, all varieties. Some are fusiform, used, evidently, as rollers, since both ends are in some cases polished by the friction with the hands, others as obviously used for pounding, as the more or less rectangular form precludes the possibility of rolling them; one of these is three inches square and nearly a foot and a-half long, flat on all sides; other specimens are flat on two sides and rounded on the other two; others are club-shaped, and so on.

Pipes are rarely found; in all I know of no more than six perfect specimens, though others may be in existence, and probably others have been found and destroyed. All of those which I have seen are well made, and polished, and while, as compared with the elaborately carved specimens from the mounds, our Vermont specimens appear very plain, yet they are not of inferior workmanship though simpler in form. Only one specimen exhibits any attempt at imitation of animal form, and this not to a very high degree. It is prolonged on one side of the rim to form what appears to be the beak of a bird. The form of this pipe, Fig. 4, is cylindrical, with an aperture for the stem about half way between the rim of the bowl and the base, and transversely to this there is another hole through the base as if for suspension when not in use. It is over two and a-half inches long, and rather more than one inch in its longest diameter, the cross section being oval. It is made of a compact, gray, mottled limestone, well polished over the outside and on the inside of the bowl.

Another pipe of somewhat different form, made of black limestone, was found on an island in the lake. This is well polished, the upper part cylindrical, or rather urn-shaped; below this there is a narrow rectangular space, and below this it is contracted and wedge-shaped. The lower end is deeply notched. It is larger than the preceding, being three and a-half inches long. The bowl is very well made and, as in the former specimen, the stem enters at the side near the middle. Another pipe of dark clouded gypsum, highly polished, is in general form like that of a modern clay pipe. This is described in Vol. v, page 13, of the *NATURALIST*. Others I will not take space to describe.

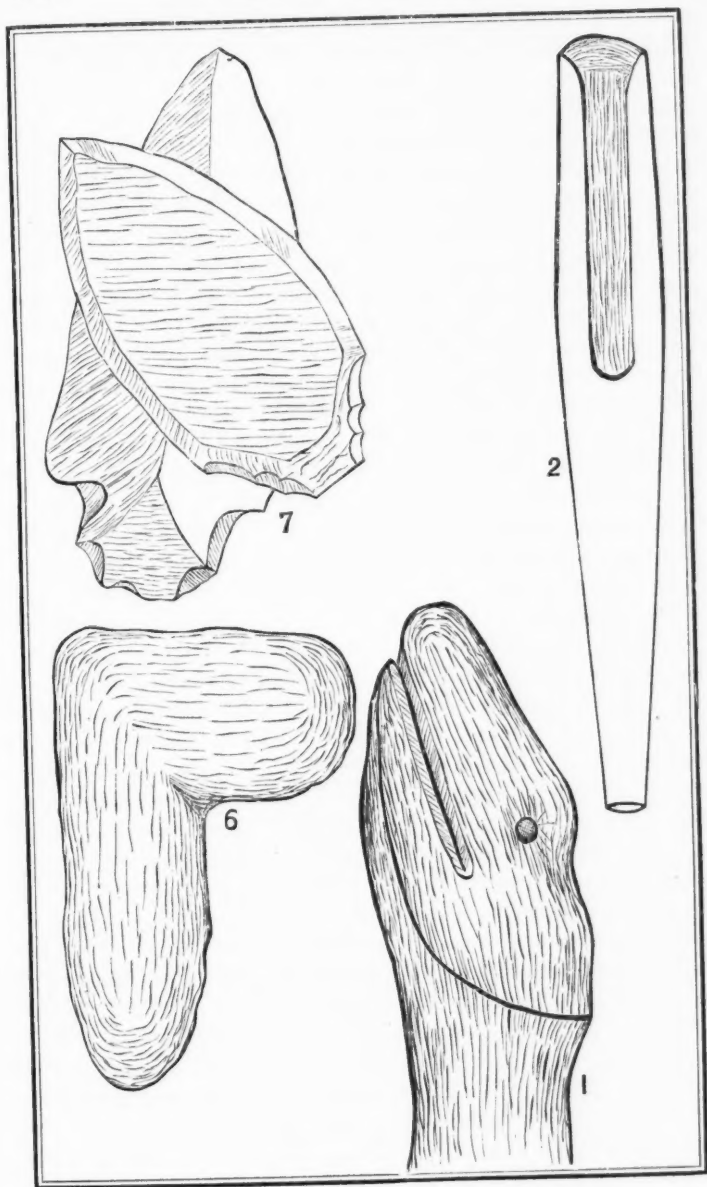


PLATE II. Perkins on the Archæology of Vermont.

Gorgetts, with one hole or two, are found all over the region we are considering. As is the case elsewhere, these are usually made of some compact, fine-grained stone that is capable of taking a smooth polish. Slate is the most common material in those that I have seen, sometimes red roofing slate, often a dark-greenish talcose slate veined with black. The gorgets with one hole are less common and less elegantly made than those with two, and the material seems less carefully selected. Of the two-hole stones, those of rectangular outline are most abundant, not that all these are rectangular, but with some modification of this form, as with corners cut off making an octagonal figure, or rounded more or less. In these, as in the banner stones, we find, in Vermont, many specimens closely resembling those found in the Mississippi valley. A greater range was possible in the choice of material of which to make "banner stones" for, as they are often thick, a material which would readily cleave into thin flat pieces was not essential, as it was in case of the manufacture of gorgets. Accordingly we find the banner stones made not only of slate, like that of which the gorgets were most often made, but also of limestone, greenstone, syenite, &c. With one exception, and perhaps that was for a different purpose, all the banner stones are perforated, sometimes by a hole of considerable size, and the regularity which we find in the perforation of very hard stones is often very remarkable, as is also the finish of the entire specimen.

The "boat stones" alluded to in speaking of the Swanton graves are also found in other places, though nowhere common. Some of these are deeply excavated on the upper or flat side, others but very slightly or not at all. In the selection of material for the manufacture of the different classes of what are considered ornamental articles, some principle was adopted which we cannot understand, for while stone that was attractive in color was used, much that could easily have been obtained and that would have made, so far as our judgment goes, much more beautiful objects, was neglected. For example, in many places on the shore of Lake Champlain, a fine black slate conspicuously veined and clouded with pure white satin spar abounds, and everyone is familiar with the fact that a great variety of marble is abundant in Vermont, and much of this crops out on the surface and could have been easily obtained, but when we search in collections of archæological objects for specimens made of these materials, we

search almost in vain. With the exception of one of the carved heads mentioned above, which is of white marble, I know of no specimen made from any of the kinds of stones mentioned. As a general rule, I think that the stone implements found in the Champlain valley are made of less beautiful material than those from the Mississippi valley, so that if we could see collections of similar objects from each locality side by side, there would be a noticeable difference in brightness and variety of color. This is especially true when we consider only those objects made of the different varieties of siliceous stone. It is not altogether owing, it may be, to any lack of taste in the selection of material for making arrow and spearheads, but to the fact that the kinds of stone conveniently accessible to the New England tribes, which were suitable for flaking, were fewer and less beautiful than those found in the West. Occasionally jasper or agate, or some attractive bit of stone was brought from Lake Superior or the Mississippi, and specimens made from such imported material are at once conspicuous in a collection on account of their greater beauty, but ordinarily the less brightly-colored materials, the gray quartzites, dull brown or black hornstones, and bluish or milky quartz, such as could be taken from ledges near at hand, furnished the staple for flaked articles, while pebbles from the drift somewhat increased the variety. Fine grained flint, prettily veined jaspers and agates are not wanting, but quartzites were largely used, and our collections lack much of the beauty which we see in those from other localities. Nevertheless some of the milk-white quartz specimens are very pretty, and one of the most commonly used materials, a translucent, bluish quartz, is, in fine specimens, by no means destitute of beauty.

So called "gouges," though not among our most abundant specimens, are yet relatively quite common, and of an almost endless variety of form. That all of these grooved implements were used as gouges is very doubtful. Of some of the specimens I have found it impossible to do more than conjecture the use. None of the objects found are more carefully formed or finely finished than some of these "gouges," and most of them are far more carefully made than the "chisels" or celts. Some of the larger specimens are a foot in length, of basalt or other hard stone, but yet are made with a degree of skill, as exhibited in the symmetry of form and smoothness of surface, that excites

great admiration. In some the groove is wide and deep, and reaches from end to end, each end, in some cases, being ground to an edge, in others it is short. Some are flat on both sides, others on one, others convex on both. Some have one end finished like a gouge and the opposite like a chisel, and in these the gouge end is flatter than usual and the excavated portion but little concave. Some are of such soft material, as steatite, that it is difficult to see how they could have been of much service as implements, but most are of hard stone. Several long "gouges" have been found which are somewhat peculiar in form. All of these are very finely made; in cross section they are shaped like a narrow Gothic arch, the point coming opposite the groove, or, in such as have only a short groove, the portion above this may be nearly cylindrical. Fig. 2 shows a very fine specimen of this sort which is over a foot in length. It is made of a rather hard greenish stone and is elegantly formed and polished. It is in the collection of Hon. A. B. Holbert of Essex, Vt. One of the largest of these specimens is in the collection of Dr. Kellogg, of Plattsburgh, and is eighteen inches long, with the end opposite the edge broken off, so that its entire length was probably considerably more. The groove extends through the entire length, and presents the unusual feature of being larger above the edge than just at it; the material is basalt. Another specimen, found not far from Burlington, less elegantly made and more clumsy but yet a very fine specimen, is nineteen inches long.

The different classes of chipped or flaked articles, as scrapers, rimers, knives, hatchets, spear, lance and arrow points, are found in greater or less abundance on the shores of Lake Champlain. Scrapers, similar to those found elsewhere, occur, though rather sparingly. The smaller ones are oblong, oval or nearly circular, while the larger are more triangular or lanceolate. Some of the discoid scrapers are very small, but the abruptly beveled edge is carefully chipped, and their use can scarcely be doubted, although similar disks of flint or quartz, half or three-quarters of an inch in diameter, are found, which have no such edge. Sometimes chance flakes, chipped off in making some other and larger object, have been by a little labor converted into scrapers. Some large specimens occur which have a less decided scraper edge, and may have been skin dressers.

Of knives we find many interesting specimens, exhibiting, I think, more than the usual variety of form. All that have been found on the eastern shore of the lake are chipped or flaked, but, as will be seen hereafter, ground knives have been found on the western shore. In the examination of our specimens I have often found it difficult, and sometimes impossible, to decide whether a given specimen was to be considered a knife or a lance, or a spearhead, for the "knives" pass, by indistinguishable gradations, into several other classes of implements. Moreover, I cannot doubt that often the same implement was used at one time without a handle as a knife or skin dresser, and at another fastened to a shaft as a spear or lance. Some of our Vermont knives are quite rude, others are more elegantly formed and finished, but none of them present so finished an appearance as some of the ground knives from other localities. The common oval knife with a sharp edge all around it is often found, and of various sizes, some being less than an inch in diameter, others several inches; other knives are ovate, triangular, lanceolate, linear, and many more or less irregular modifications of these forms. All of these are without stems, and most of them undoubtedly knives, used for no other purpose than cutting. Some are edged on all sides, others on only one; some are several inches long and not more than one wide, making dirk-shaped implements.

It is interesting to notice that on both shores of Lake Champlain we find the same quadrangular forms, broken across one end, as those figured by Dr. Abbott in his "Stone Age in New Jersey,"¹ and from the appearance of our specimens I am inclined to agree with him in believing that the break was not accidental, or rather, I should think it more probable that the broken end is simply the original surface of the block of flint or quartz from which the knife was flaked, and while all the other sides were chipped, this was left, perhaps for insertion in some sort of a handle of wood or bone. Stemmed or hafted knives of many forms occur abundantly all over this region, some of them shaped much like a modern knife, others more like lance or spear points, and I do not think that any definite line can be drawn between these classes of implements. In Vol. v of this magazine, p. 16, Fig. 5, a very peculiar form of what I then called a spear point, is shown about half natural size. At the time the article was written, this specimen was the only one I had ever seen, but since then several

¹ Smithsonian Report, 1875, p. 301, figs. 111, 112.

others have been found of similar character. If these specimens are to be considered as implements at all, they are better fitted for use as knives than as spear points, and on this account I will mention them here. So far as I can ascertain, no specimens of this sort have been found elsewhere, but they occur on both the Vermont and New York shores of the lake, though none have been found far from it. Of the dozen specimens which have been found, no two are alike in form or size, but they all resemble each other in being made of slate, usually red roofing slate, ground, not chipped, and with the stem notched on each side by a series of semicircular depressions. In some specimens the notches are small, in others large; one specimen having but two deep and wide notches on each side of the rather short stem, while another has five smaller ones. As has been said all are of slate, those not made from roofing slate are of drab talcose slate, except one which is of a compact mica slate. In some the surfaces are flat, beveled only near the edges, which are straight and sharp in all, while in others the whole surface is beveled from a median line. All are very regularly and finely formed; some are smooth, others show marks of grinding. Most are more or less ovate-triangular in outline, but one or two have nearly straight and parallel sides, except near to the point. Two of these specimens are shown full size in Fig. 7, but the figure does not fully represent the regularity of form of the original. One or two are so long and narrow that they seem wholly unfit for any use as implements, one especially, made of talcose slate, is nearly nine inches long and one and a-half inches in width at the base, the average width being much less. Such an implement would break with very little rough usage. The other specimens are smaller and stronger, but none would long remain intact if subjected to much hard treatment. Most of the specimens are from two and a-half to three inches long, some being a little less, some more than this. The width varies less, most of the specimens being very nearly an inch and a-half at the widest part. One or two specimens have been found which were precisely similar to those described except that the stem was without notches. None of the specimens show decided indications of having been used, and most are as fresh in appearance as when first made; this fact, added to the great weakness of some, and lack of strength in the material of all, leads me to conjecture that they may have been badges of office or something of the sort, rather than for any definite use.

Rimers and drills of the usual forms are found, though not in great numbers. Most of the perforations found in various specimens, as banner stones and tubes, were not made by means of flint drills, but by sticks of wood, or perhaps hollow reeds and sand, or some such process.

Spear, lance and arrow points are of course more abundant than any other class of specimens, and all the varieties figured by Col. Foster are found, with others differing from these. Some very singular inequilateral forms occur, like those figured by Prof. Haldeman in a recent number of the *NATURALIST*, and many others. Indeed a close examination of any large collection of flint points, will show that entirely symmetrical forms were rarely attained; by far the larger part are more or less unequal, both as regards curvature or straightness of the edge and convexity of the surfaces. One edge is usually more strongly curved than the other, and one surface more convex than the other. Often the blade is not in the same plane with the stem, but seems twisted upon it, due, as I think, less to the intention of the maker than to the fracture of the stone. From these slightly, often almost imperceptibly, unequal points, we have every gradation to those which are nearly as unsymmetrical as possible, and of these latter, some are so well chipped that I cannot regard them as "failures," but for some unknown reason intentionally of the form we find them. In comparing the specimens from the Champlain valley with those from Georgia, figured by Mr. Jones, I have been struck with the close resemblance between them; there are comparatively few of the objects described in "Antiquities of the Southern Indians," which cannot be duplicated, often exactly, in Vermont specimens. This resemblance is more noticeable because among Dr. Abbott's New Jersey specimens I find many unlike those which we have with us.

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THE ORIGIN OF THE DOMESTIC ANIMALS.

BY G. DE MORTILLET.¹

WE know that the men who lived in our region during the long quaternary, or paleolithic period, were autochthones. We have seen that they developed slowly, regularly, in a progressive, continuous manner, both from a physical as well as an

¹ Translated from *Matériaux pour l'Histoire primitive et naturelle de l'Homme*, 1879. 4e et 5e livraisons.

industrial point of view, from the beginning of the quaternary up to the present (actuelle), or neolithic epoch. During all this vast lapse of time nothing happened to interrupt the two-fold, ascending, progressive movement; nothing has seemed to disturb it. No new element has been suddenly added. This movement has, then, operated in the local, autochthonous population without intrusion and mixture of foreign populations.

At the beginning of the present epoch, on the contrary, we see all at once a new civilization introduced without transitional steps. The neolithic, or polished-stone, industry, to which I have given the name of *Robenhausienne*, appeared all at once without the least gradation, and at the same time we find a new human type, the brachycephalic type. There was here an invasion. A population from abroad brought here all at once not only the polished hatchet, which is only a single fact, but also, and what is especially noteworthy, pottery, domestic animals, the cereals, monuments, dolmens and menhirs, and finally, religious ideas, the worship of the dead. All this was completely unknown to the autochthonous population of geological times, to the paleolithic people. We see that with the polished hatchet appeared six domestic animals, the dog, goat, sheep, ox, horse and pig; three cereals, wheat, barley and rye, accompanied by a textile plant, the flax. It is evident that there took place an industrial revolution which corresponds to that produced in America by the arrival of the Europeans. It is incontestably the fact that here was a great invasion—great at least from the point of view of the results produced. It was the first which took place in Western Europe.

Whence did this invasion come? The study of the domestic animals may tell us. We need not urge the case of the dog, which may have preceded the arrival of the invaders. Indeed, it is the animal the most anciently and completely domesticated. Of all the domestic animals, it is the only one which man has not been obliged to care for and watch. We may say, on the contrary, that he watches man. Very valuable from the two-fold point of view of personal necessity and of the chase, it was held in high esteem by the savage and nomadic peoples who were always on the *qui vive* and lived only by the products of the chase. In fact, the dog is, in our day, quite what he was among the people who had no other domestic animals. We may now say some words as to his origin.

Some authors have derived the dog from the fox. This view is not probable, because there exists in the fox a particular disposition which is not found in dogs.

It is said also that the dog has descended from the wolf or jackal. This is possible, but is not probable; wolves and jackals do not voluntarily breed with dogs.

We meet in the quaternary beds and deposits of France with the remains of a species of *Canidæ* more nearly allied to the domestic dog than to the wolf or fox. But these remains are rare, wholly exceptional in our region. If this canid has given origin to some one of our domestic dogs, which is possible, this could not have occurred in our country. This event happened when the quaternary canid was in its own country, where it abounded and lived in continual contact with man.

Among savage animals which may have given origin to the domestic dog are found the *colson* and *buansu*, veritable wild dogs. They actually inhabit the regions of India situated between the Lower Himalaya and the coast of Coromandel. They are perhaps the emigrated descendants of the quaternary canid of which I shall speak presently, and indeed they have close osteological resemblances.

Our actual races of dogs are so numerous, so varied in form, so different that very probably they have had different origins. Certainly there is one which has come from the *cabêru*, the wild dog of Abyssinia, which has been found as far as the center of Africa. Certainly one of the oldest races of dogs in Egypt is the domesticated *cabêru*. Indeed, on the Egyptian pictures which go back to the remotest periods, to the fourth and even to the third dynasty, that is to say from 3000 to 4000 years before our era, we have seen certain large greyhounds. Indeed, the *cabêru* is extremely near the greyhound.

But we will not speak farther of the dog. The five other domestic animals which we have seen to have appeared in Western Europe contemporaneously with the polished hatchet and with pottery are, the horse, ox, goat, sheep and pig.

Since all the animals have had quaternary ancestors in our region, they have therefore been supposed to have been domesticated by us. Certain naturalists, indeed, assume that this has been the case. An attentive study of facts contradicts this assertion. The domestic animals appeared all together, contempora-

neously, associated with a totally new civilization which arrived simultaneously. They were, then, imported, like the civilization which they accompanied. They were not, therefore, domesticated there as indigenous products, but foreign products introduced into the country by new arrivals, by invaders.

This general proof of the non-indigenous domestication is corroborated by the study of details. If, at the quaternary epoch, the horse, the ox, the goat were ancestral representatives in all France, it was not so with the sheep. In our quaternary deposits it has only occurred on the Mediterranean shore. It has been found in Hérault; it is abundant at Menton. This is evidently the northern limit of its habitat, and consequently this cannot be its place of domestication.

The fact is still more explicit as regards the pig. In the Robenhausian, or polished-stone epoch, we have recognized two species of domestic pigs in France, in Switzerland and in Italy. To the ordinary pig which originated from the wild boar, an animal abundant in our quaternary deposits, may be added the turf pig, very different, which has no other ancestor in the countries which I have just named. To learn where the domestic animals have come from, we should take into account the geographical area of their savage ancestral types. At the quaternary epoch the wild horse, identical with the domestic horse, was extremely abundant, not only in Western Europe but also in Asia Minor, on both slopes of the Caucasus and over all the basin of the Caspian sea. It extends still farther to the east. Its area of habitation traversed Europe and Asia.

The wild quaternary ox had a habitat a little less extended than the horse; nevertheless, like the latter, it extended from our region very far into Western Asia. Without speaking of the species with the hump, like the aurochs, there were two types of true oxen, the urus, of very great size, and another ox of much less size. Our domestic oxen certainly originated from one of these two types, perhaps from both.

The domestic goat may likewise have been derived from the bouquetin of the Alps and of Spain, as also from the *égagre*, the bouquetin of Crete, of Southern Caucasus, of Armenia and of Persia. Bouquetins and *égagres* breed spontaneously with the goat and produce very readily fertile hybrids, which proves that there exists between them strong bonds of parentage.

The sheep is a transformation of the mouflon of Corsica, of Sardinia, of Cyprus, which joins in the east, by Asia Minor, the argali sheep (mouflon) of Grand Tartary.

Finally, the ordinary pig is evidently a modified wild boar. Indeed, our pig set at liberty assumes the characters of the wild boar, and the latter, raised like our pigs, end by resembling them. Like the horse, or the ox, the wild boar ranges from Europe to Asia. Moreover, it is only in Asia that we find wild another swine, which is allied to the turf pig.

The only country containing all the ancestral types of domestic animals introduced into Western Europe at the Robenhausian epoch is that part of Asia which extends between the Mediterranean, the Grecian archipelago, the Black sea, Caucasus, the Caspian sea, the limits of Afghanistan, the north of Persia and Assyria. We should conclude that it is from that region that has proceeded the great wave of migration which has brought us, with the civilization of the polished stone epoch, our first domestic animals.

The study of cultivated plants confirms the facts deduced from the study of the animals. The invaders of the west of Europe, which at the Robenhausian epoch brought us the domestic animals, also introduced to us the three cereals, wheat, barley and rye. It is an agriculture transferred, transplanted all at once, and which consequently has not taken birth in our regions. The three cereals which I have just cited have had no ancestors among us. Among all the wild grasses, which have been well studied and are perfectly known, none approach the wheat, barley or rye. We are ignorant, it is true, of the ancestral forms of these three cereals, nevertheless, botanists are quite generally agreed that they came from the Caucasian regions. A certain fact, which militates in favor of this opinion, is, that the cereals named, whenever they have been cultivated in our fields, sometimes leave sporadic or spontaneous descendants; but they soon disappear at the end of two or three years and are no more to be seen. In the Caucasus, on the contrary, these sporadic and spontaneous individuals, escaped from cultivation, perpetuate themselves for a series of several years, besides that, they are generally more frequent. This proves that there they are nearer the place of origin, if that be not the place of origin itself.

With the wheat, barley and rye the Robenhausian invaders

brought us a textile plant, of which they made great use, *i. e.*, flax. This plant is most useful in determining with precision the point of departure of the Robenhausian civilization. This civilization did not come from North-eastern Asia; for in China they have the hemp, a textile plant much more useful than flax; but the hemp was completely unknown in Western Europe during the entire polished stone epoch.

Flax also was very widely spread in ancient Egypt, to the exclusion of hemp. It can perhaps be inferred from this that the civilization which we have studied has come from Egypt, or at least from South-western Asia. To recognize the slight foundation of this assertion it suffices to return to the domestic animals. We have seen that the great migration of the Robenhausian or polished stone epoch brought us the domestic horse. However, the domestic horse, far from having originated in Egypt, was not introduced into that country until after the time of the pastoral kings, at the beginning of the eighteenth dynasty, in the eighteenth century before our era. The first domestic equid of Egypt was the ass, an animal of African origin. But the ass did not occur at all in Europe during the stone age. This absence of the ass, a very useful animal which lives very well in our climate, is also a proof that the civilization of the first great European migration did not come from South-western Asia, which has wild horses allied to the ass, such as the onager, which inhabits the shores of the Indus and extends to Southern Persia; or the hemione of Upper Asia and Mongolia. Everything in the study of the domestic animals and cultivated plants concurs, then, to prove that the first great migration which entered the south-west of Europe, at the Robenhausian epoch, came from Asia Minor, Armenia and the Caucasus. From our actual knowledge, we cannot establish whether this migration has followed the route of the land or even the course of the sea; but this much is certain, that in either case it reached us by the Mediterranean basin. If, without pastoral and agricultural facts, we seek proofs of this fact, we shall find in it the retrograde artistic movement, and in the introduction of architecture or the appearance of a monument, the *dolmen*.

The last populations of the geological periods, that of the Magdalenian epoch which terminated this period, had a very pronounced artistic sentiment. We have found in France, in Switzer-

land, in Belgium and in England, in the deposits of this epoch, true works of art. These are engravings and sculptures representing in a very natural manner, but very true and well studied, representations of animals.

But with the Robenhausian invasion this first start in art completely disappeared. We see no more ornamentation, or only rudiments exist, as in certain dolmens of the Mœbihan. These consist simply of fantastic combinations of different lines representing no living object. In the region whence the Robenhausian migration proceeded, we see certain peoples, as in Persia, who in decoration, still in our time, make only combinations of lines.

The first monuments, dolmens and menhirs, were brought to us by the Robenhausian migration. We find these monuments at the north and south of the region whence has started this migration. We have discovered dolmens in Palestine, especially among the Moabites; we have found them still more to the north of Asia Minor. On the other hand, it is well known that dolmens are found in the Caucasus, and that they pass into the Crimea.

Finally, at what date has the migration which we have just studied, taken place? Certainly it is very rash to seek the date, even approximate, of events so distant. However, it seems to me well to divert our researches in this direction; so without according them much importance, I proceed, finally, to present some considerations in this respect. It seems to me that we can affirm that the Robenhausian migration was anterior to the great Egyptian civilization. Indeed, the men comprising this migration did not know, for a long time, indeed a very long time, anything more than the use of stone. The Egyptian civilization, from the first dynasty, was in possession of metals. We submit that there were no relations between the Egyptians and the countries whence the emigrants departed, but it was not long before this relation was to be established, since from the fifth and the sixth dynasty Egypt had borrowed much from Asia, notably that which relates to the working of metals. The populations which invaded Europe had, therefore, already quitted Asia at this epoch.

HISTORICAL SKETCH OF THE SCIENCE OF BOTANY
IN NORTH AMERICA FROM 1635 TO 1840.

BY FREDERICK BRENDL.

A HISTORY of the science of botany in North America means not in this sketch a history of that science in all its branches, but rather the history of traveling and local collectors, and of descriptive botany so far as it concerns American plants. For until Prof. A. Gray's popular book, "How Plants Grow" appeared in 1858, not a single work of any importance was published in this country, either on anatomy or on the physiology of plants, not even a single one of the many systems ever proposed had its origin in America. And yet the labors of American and foreign scientists in America contributed their large share to the advancement of science. They furnished the material for the work in all the other branches of botany, and particularly in the geography of plants. Most of them did a toilsome work, exposed in the wilderness to manifold fatigues and perils; many died far from home on the glorious battlefield of science, as it were, sword in hand; some a violent death, others swept away by a pernicious climate.

1635-1800.—It was in 1635 that the first book on North American plants ever written, was published by Jacques Philippe Cornut, a French physician. He described Canadian plants brought over to Europe, in a book entitled: *Canadensium Plantarum Historia*. It is illustrated by good drawings, most of the species being recognizable at first sight, though the names given are quite different from those now in use. But the work does not contain, as might be inferred from the title, Canadian plants only, but also some others from Spain and the Orient. Not until thirty-seven years afterward, in 1672, was another account of American plants given by John Josselyn, in a book entitled *Rariora Novæ Angliæ*, and in 1674, in an account of two voyages in New England.

At the same time, in 1672, Wm. Hughes published in London, *The American Physician, or a Treatise of the Roots, Plants, etc.*

In Ray's *Historia Plantarum*, 1688, second volume, we find a "Catalogus plantarum in Virginia observatarum," by John Banister, an English missionary and botanist, who came, in 1680, to Virginia, where he made his collections. The same catalogue

was republished, in 1707, in Petiver's *Memoirs for the Curious*. About the same time an Englishman, Wm. Vernon, and a German, David Krieg, collected, in Maryland, several hundred new species, which they sent to Ray, Petiver, Sir Hans Sloane and others.

James Petiver, a London apothecary, described, in 1706, in "*Pterigraphia Americana*," some North American ferns, and Leonard Plukenet, a London physician who lived from 1642 to 1706, figured many North American plants in "*Almagestum Botanicum*," 1696, and "*Almatheum Botanicum*," 1705.

The same year came the English naturalist, John Clayton, (1685-1773), to Virginia, where he made his collections, afterwards described by Gronovius, a distinguished Dutch botanist at the University of Leyden, in Holland. His "*Flora Virginica Exhibens Plantas, quas J. Clayton in Virginia collegit*," was published in 1743, and a second edition by Gronovius, the son, 1762, augmented by observations of Clayton, Colden, Mitchell and Kalm.

From 1712 to 1719, Mark Catesby, another English naturalist, collected in Virginia. A second time he started from England and arrived, in 1722, in South Carolina. He traveled three years in that State, in Georgia and Florida, visited the Bahamas and came back to England in 1726, where he published from 1731 to 1743, the valuable work, "*The Natural History of Carolina, Florida and the Bahama islands*," two volumes in folio and a supplement with two hundred and twenty colored plates. The descriptions are in English and French; a German edition was published in 1750. After his death (1749) was published his *Hortus Britanno-Americanus*, in which he described the trees and shrubs of the British colonies in North America adapted to the soil and climate of England. London, 1763.

Here may be mentioned a natural history of North Carolina, by Brickell, in Dublin, 1737.

The Swedish naturalist, Peter Kalm, explored the eastern part of Pennsylvania, New Jersey, New York and Canada during the years 1748 to 1751. He was sent by the Swedish government at the proposal of Linnæus, whose pupil he was. The original motive was the American mulberry (*Morus rubra*), which was known to grow as far north as Canada, in a climate similar to that of Sweden. It was intended to acclimatize the tree and to

introduce the culture of the silkworm in Sweden. The extensive botanical collections were worked up by Linnæus and embodied in his herbarium, where they exist yet.

Linnæus published, 1753, the first edition of his "*Species Plantarum*," in which he described 5938 species, all that was known at that time, and of which 5323 were phænogamous. In all his writings the number of species he was acquainted with was 8551 (7728 phænogamous and 823 cryptogamous). Amongst these are 1075 species either common to the eastern and western continents or only North American, inclusive of the Arctic regions and exclusive of Mexico.

Another contributor to the herbarium of Linnæus was Cadwallader Colden, Lt. Governor of New York, who was born in Scotland, 1688, and died in New York, 1776. The catalogue of his collection is published in "*Acta Societatis Scientiarum Upsalensis*, 1743-1744. His daughter, Miss Jenny Colden, wrote a *Flora of New York*, with drawings, the manuscript of which she transferred, before her death, to Wangenheim; afterwards it was incorporated into the Banksian Library, but never published.

Some Canadian plants were described by the French missionary, Xavier de Charlevoix, in his "*Histoire et description générale de la nouvelle France*, 1744." About the same time, John Bartram (born 1701, died 1777 in Philadelphia) traveled to Lake Ontario, and published his valuable observations in 1751. His son, Wm. Bartram (1739-1823), was the first to extend his botanical excursions to the Southern Alleghanies. He left Philadelphia in 1773, traveled through Florida and Georgia to the Cherokee country, and went through Alabama to Mobile in 1776. He published his voyage in Philadelphia, 1791. This valuable work was afterwards translated into the German, in 1794, and in French, in 1799.

John Mitchell, an American physician in Virginia, published additions to Linnæus' first edition of *Genera Plantarum* in his "*Dissertatio de Principiis Botanicorum*."

Reinhold Forster, naturalist to Cook's second expedition, compiled a catalogue of the plants of North America, in 1771, without descriptions.

A number of species, common to the Southern States and the West Indies, were made known by the important discoveries of Chas. Plumier (1690-1695), of Nic. Jos. de Jacquin (1754-1759)

and of Olaf Swartz (1785-1789). Only the latter spent a year on the North American continent before he went to the West Indies, where he alone discovered and described 850 new species. The first came from France, the second from Germany, the last from Sweden.

At that time Humphrey Marshall made the woody plants his special study. He published his "*Arboretum Americanum*," containing 276 species, in Philadelphia, 1785, which in 1788 was republished in Germany. The German foresters took a special interest in the matter, as many American woody plants had already found their way into the German nurseries, and by some experiments made it was known that for many purposes some sorts of American timber were superior to the indigenous, and as the greater demand for fuel in some industrial districts resulted in a final scarcity of wood, they thought that the cultivation of American timber in the German forests would be, by its more rapid growth, of great advantage.

Captain¹ Wangenheim, of the Hessian troops, afterwards Prussian forest-officer, studied, during his eight years service in America, the timber of this country with regard to its usefulness and practicability of culture. In 1781 he published descriptions of some North American trees, and after his return to Germany a larger work with drawings, 1787. There are many good observations on the soil and climate and their influence upon the culture of the different species, but the drawings are inferior, and in one there is a great error which is worthy of notice. On plate 18 is figured the leaf of *Carya olivæformis* and what is intended to represent its fruit, but looks rather like a pea nut. Probably he had never seen the nut, which he described as "kidney shaped," though he examined, in Wm. Prince's nursery at Flushing, on Long Island, the young tree not yet bearing. As he was eager to obtain the fruit, somebody by mistake, or perhaps for jest, may have given to him a pea nut for a pecan nut, which he drew. He gives a short history of the tree, which was unknown in the English colonies until the peace of 1762, when by chance some fur-traders brought a small number of the nuts to New York. Wm. Prince planted (1772) thirty nuts and raised ten plants, which (except two retained for propagation) he sold to England at ten guineas a piece.

¹ Here may be corrected an error in the preface of Torrey's *Flora of New York*, Wangenheim was not a surgeon nor an M. D.

In 1783, was sent over to America from Vienna, a scientific expedition under the charge of Prof. Marter, assisted by Dr. Stupicz, two gardeners and one designer. From Philadelphia they made excursions in Pennsylvania, to Virginia and Carolina. In the latter State, Marter met Dr. Schoepf, surgeon in the service of the Margrave of Ansbach, another German petit-tyrant who sold his poor subjects to the English. Both made together an excursion to Florida and the Bahamas. Marter brought large collections to Vienna, and Dr. Schoepf afterwards published a "*Materia Medica Americana*," Erlangen, 1787, and his "*Travels Through the North American States*," Erlangen, 1788.

An Italian nobleman, Luigi Castiglioni, traveled from 1785 to 1787 in the Eastern States, and published, 1790, his "*Viaggio negli Stati Uniti del America Settentrionale*," in two volumes. The latter half of the second volume contains observations on the useful plants. Like Wangenheim he gives to his countrymen some hints in regard to acclimatation. He describes most of the eastern and southern woody plants and gives a few good drawings (*Franklinia alatamaha* of Marshall, now *Gordonia pubescens*, *Quercus banisteri* and *Rhus venenata*). He made himself acquainted with the scientific men of the country, and in a passage (p. 163 second volume) where he objects to the assertion of Raynal (*Histoire Philosophique et Politique*), that America has never produced a single prominent man, be it in science, art or any other branch, he names, after mentioning a number of military, political and scientific men, the botanists, John Bartram and sons, Humphrey Marshall, Manasseh Cutler and Dr. James Greenway of Virginia, who made valuable collections.

Thomas Walter, the author of the *Flora Caroliniana*, published in London, 1787, was born, 1740, in Hampshire in England. He made his collections on a small area of scarcely more than twenty-five square miles on the Santee river, in South Carolina, but though he declares his collection very incomplete, it contains over a thousand species. He is a most modest man and not an over hasty species-maker. Whenever he is in doubt about a species he does not name it, but calls it "anonymous," for only few, he says in the preface, are allowed to name, and so he concedes to those who are the leaders in science, the right to name those plants now first described. To his name on the title he appends "agricola" (farmer), a learned farmer indeed, as the

whole book is written in Latin. In front of the book is a copper-plate (representing *Magnolia frazeri* Walt.) with the inscription: "To Thomas Walter, Esq., this plate of the new auriculated *Magnolia* is presented as a testimony of gratitude and esteem by his much obliged humble servant, John Fraser."

This man, John Fraser, was a Scotch botanist who collected from 1780 to 1784 in New Foundland, and from 1785 to 1796 in the United States. After a voyage in Russia he came again to America with his eldest son, John, in 1799. He visited the Alleghanies, where before, in 1789, he had traveled with Michaux, and on the summit of the Great Roan it was that he discovered the beautiful *Rhododendron catawbiense*, now cultivated in many varieties. After a visit on the island of Cuba, where he met Humboldt and Bonpland, father and son returned to England in 1802. Once more, 1807, both came to North America. The elder Fraser died, 1811, in Glasgow, but his son returned to America, where he continued his excursions up to 1817.

Palisot de Beauvais (1755-1820) came from St. Domingo to Philadelphia in 1791. He extended his excursions to the Cherokee country in the Southern Alleghanies. Of his collections, a large part was lost by shipwreck.

L. A. G. Bosc (1759-1828), a friend of Michaux, came from France to Charleston, in 1798, made some excursions in the vicinity of that city, traveled northward to Wilmington, N. C., and westward to the line of Tennessee. With a collection of 1600 species, chiefly grasses and cryptogamous plants, he returned in 1800, to France. Parts of his collection are found in the herbaria of Ventenat, Martius, Moretti and De Candolle.

Another Frenchman ought to be mentioned here not as a botanist, but because the matter he treated of is in near relation to botany. The Count Volney came to North America as an exile in 1795, and lived there till 1798. He had traveled previously in the Orient and had written the famous work, "The Ruins." In America he studied the soil and the climate. His "Tableau du climat et du sol des Etats Unis d'Amerique," was published in Paris, 1822. Though we cannot agree with all he said, particularly not with the statement that the ancient and annual fires of the Indians *caused* the prairies, the book contains much interesting matter. In the second chapter he describes, in general, the appearance of the country, particularly the extensive

woodlands, which he brings into three categories, as the southern, the middle and the northern, each characterized by its peculiar trees. Very interesting to Western men is his article on the colony at Vincennes, on the Wabash, and the early French life in Illinois.

The most important collections of this period were made by André Michaux, born in France, 1746. Before Michaux came to this country, he had traveled in Persia, 1782 to 1785. Then, in September, 1785, he embarked for New York, where he arrived in November of the same year. He established two gardens, one in New Jersey, the other near Charleston, S. C., for he was sent by the French government to collect living plants, to be transported to France. His excursions extended from Canada to Florida, and, in the west, to the Mississippi; farther than any collector before him had traveled. From Charleston he started for his first tour to the southern Alleghanies, in April, 1787, and returned the 1st of July; went to Philadelphia and New York, and returned to Charleston in August. Then, in February, 1788, he embarked for St. Augustine, Florida; returned to Charleston, and started again for the Alleghanies. During the following winter he was on the Bahama islands, and brought back to Charleston eight hundred and sixty young trees and shrubs. Then he made several excursions to the Alleghanies of North Carolina, through the valley of Virginia to Maryland and Pennsylvania. From New York he returned to South Carolina, via Baltimore, Richmond and Wilmington, and went again to the mountains. He returned to his nursery with twenty-five hundred young trees, besides many shrubs and other plants. In March, 1792, he sold his nursery near Charleston, and went to Philadelphia, collected in New Jersey and around New York; traveled via Albany and the Champlain lake to Montreal and Quebec, and came back from there to Philadelphia in December.

In July, 1793, he undertook his great journey to the far west; he crossed the Alleghanies of Pennsylvania, descended the Ohio to Louisville; crossed Kentucky and Virginia, back to Philadelphia. In 1794 he visited again the Southern States; in May, 1795, he was in East Tennessee, crossed the Cumberland mountains, arrived, in July, at Louisville, traveled the Wabash up to Vincennes, crossed Illinois, descended the Mississippi in a little boat to the mouth of the Ohio, followed the Cumberland river up

to Clarksville, and arrived, via Louisville and North Carolina, at Charleston in August, 1796.

His travels in the Alleghanies are more particularly spoken of by Prof. Asa Gray, in his "Notes of a botanical excursion to the mountains of North Carolina." He had already sent to France more than sixty thousand living woody plants, and forty boxes with seeds, when he returned in 1796. Unfortunately, he suffered shipwreck off the coast of Holland, but he, and the collections which he brought, were saved, though the latter were damaged. He arrived at Paris in December, 1796, and published, in 1801, his great work on the American oaks, with excellent engravings. He then prepared the material for his *Flora Boreali-Americana*, but did not live to see it published.

Though he had desired to return to America, he accepted a proposition of Captain Baudin, to take part in an expedition to New Holland, and embarked on the 18th of October, 1801. Arrived in Isle de France, he left the expedition for Madagascar, where a malignant fever caused his death, on the 13th of November, 1802.

Louis Claude Richard arranged the material of his *Flora*, and, in 1803, it was published by François André Michaux, the son. In this work are described 596 genera (555 vascular and 41 cellular) and 1740 species (1641 vascular and 99 cellular). Though many changes and reductions have been made in the course of time, 17 of the genera, proposed by him as new, are valid yet, and about 350 species.

Considering the vast area he traveled over, often without company, the poor facilities for traveling at that time, the troubles he had to undergo in transporting so many living trees and shrubs, the dangers he had to fear, risking his scalp at every step in the Western wilderness, we must admire that indefatigable traveler. His name stands as a prominent landmark at the dividing line of two periods, from which the labors of working botanists in this country took a new departure.

1800—1840.—Till then, at the close of the eighteenth century, as we have seen, most of the work was done by foreigners, partly engaged by European institutions or by private men. The few Americans did the work at their own expense, for there was no subvention by the Government at that time. Michaux, after his return from Canada, had, in 1792, entered into negotiation with

the Government about an expedition across the continent, but without any result. Indeed, the Union, with her four millions of inhabitants, was not a rich country at that time; she could not support scientific pursuits with the same liberality as she, in our times, does with her forty millions. And yet, ten years afterwards, an expedition was sent out under the command of Meriwether Lewis and Daniel Clark, the first that ever crossed the continent.

Before this expedition, only two botanists had visited the Pacific coast, Haenke and Menzies.

Thaddaeus Haenke (1761-1817), botanist with the Spanish expedition under Malaspina, collected about nine thousand species, of which a small part were from Northern California, in 1789. The herbarium is in the National Museum of Bohemia. Haenke did not return to Europe, but settled at Cochabamba, in Bolivia, where he died, 1817. Presl published the description of a part of his collections, under the title: *Reliquiæ Haenkeanæ*; 2 vols., with 72 plates. Here, by-the-by, may be corrected a geographical error, such as may often be found in learned writings. In Kunth's *Enumeratio*, vol III, page 361, under *Juncus falcatus*, we read: a Haenke lectus prope Monte Real (Canada). But Haenke was never in Canada, and it is meant Monterey, in California.

Archibald Menzies (1754-1842), a Scotchman, surgeon in the British marine, came first, 1786, to the North-west coast, and made there some collections. Afterwards, he took part in the famous expedition under the command of Vancouver (1791-95), and visited, several times, San Francisco, Monterey and Nutka Sound, on Vancouver Island. His collections are incorporated in the herbarium of the Edinburg Botanical Society, and, partly, in Hooker's herbarium.

This was all that was known of the botany of the northern Pacific coast, when the first American exploring expedition started from St. Louis, on the 14th of May, 1804. The party ascended the Missouri in keel-boats, corded by hand; wintered at Fort Mandan; crossed, in the next season, the Rocky mountains (at the Bitter-root mountains), and descended the Lewis fork and the Columbia river. The botanical collection from the Rocky mountains was, unfortunately, lost; only one hundred and fifty species, collected during the rapid return-march, were saved. These plants were described by Frederick Pursh.

The German botanist, Frederick Pursh, came to North America in 1799, a young man then, but not as young as he is made in Pritzel's *Thesaurus*, which, on account of so many errors in printing, is, in regard to dates, unreliable. According to Pritzel, he was born in 1794! What a young botanist, crossing the Atlantic, five years old! He was born in 1774.

"My first object after my arrival in America," he says in the preface to his *Flora*, "was to form an acquaintance with all those interested in the study of botany. Among these I had the pleasure to account one of the earliest, and, ever after, the most valuable, the Rev. Dr. Mühlenberg, of Lancaster, Pa., a gentleman whose industry and zeal for the science can only be surpassed by the accuracy and acuteness of his observations."

Heinrich Ludwig Mühlenberg, born 1756, was a Lutheran preacher in Lancaster, Pa., where he died, 1817. He published a catalogue of North American plants, 1813 (second edition 1818), and a "Description of North American Grasses," 1817.

Then Pursh visited Mr. Humphrey Marshall, already mentioned, the younger John Bartram and his brother William Bartram; Mr. John Lyon, who had the management of Mr. William Hamilton's gardens, and whose successor he was from 1802 to 1805, and Dr. Benjamin S. Barton, Professor of Botany in the University of Pennsylvania, who lived from 1766 to 1815, the author of "Collections for an Essay toward a *Materia Medica* of the United States," 1798 (second edition 1812-1814); of a "*Flora Virginica*," first part, 1812, but not continued, and of "Geographical view of trees and shrubs," 1809.

In 1805, Pursh set out for the Alleghanies of Virginia and Maryland; in 1806 he went to the Northern States, as far as New Hampshire; in 1807 he took charge of Professor Hosack's botanical garden of New York; in 1810 he visited the West Indian islands, and returning in 1811, landed in Maine, and embarked the same year in New York for England, where he published his *Flora Americæ Septentrionalis*, London, 1814, in 2 vols., with 24 engravings. This *Flora* contains about 740 genera and nearly 3000 species.

It will be easily understood that Pursh's *Flora*, which was published eleven years after Michaux's, must be richer in genera and species, when we consider that Michaux described only such species as he collected himself, and that Pursh received contribu-

tions from many parties. Except the small collection of Lewis and Clark, he used the herbaria of J. Lyon and Barton in Philadelphia, of Hosack in New York, of Le Conte in Georgia, of Peck in Massachusetts, and a number of species received from Alois Ensen, an Austrian gardener, who made large collections in the Southern States and Western territories, which are now in the Imperial Museum of Natural History in Vienna.

Then, in England, Pursh examined the herbaria of Clayton, Pallas, Plukenet, Catesby and Walter. In Bank's herbarium he found a number of the plants collected by Archibald Menzies on the North-west coast.

Pursh returned to America with the intention to explore Canada, where he died in 1820.

C. C. Robin,¹ a Frenchman, traveled, 1802-1806, in Louisiana and West Florida, which at that time included the southern parts of the States of Mississippi and Alabama. The incidents of his voyages he published in 1807, and in an appendix he described the plants, found on his tour, very vaguely, as he indeed was not a botanist. It is not known that he ever brought to France the specimens of those plants. From this written material was fabricated, by Rafinesque, a fancy work called *Florula Ludoviciana*, published in New York, 1817.

Constantin Samuel Rafinesque-Schmaltz is his full name. He was a Sicilian, and came to America in 1802, where he remained three years, and then again in 1815, and never returned, for he died in 1840, in this country. A. Gray published, in the *American Journal of Science and Arts*, a paper on his numerous botanical writings. Gray calls him an eccentric but certainly gifted man. It is true, some of his observations are really good, some of his genera and species are acknowledged now and will be in the future, but the greater part are trash; most of his numerous species can never be found, for they have no real existence in nature. He was a polygrapher—he wrote on everything; even poetry, the worst of all, he committed. At last he made a perfect fool of himself; he had such a mania for classification and registration, that he once proposed—twelve new species of thunder and lightning! His travels extended, in 1802-4, over the States of New Jersey, Pennsylvania, Maryland, Delaware and Virginia; in

¹ Not the godfather of the genus *Robinia*. That was Jean Robin, who lived from 1550 to 1629, in Paris.

1815 and 1816, mostly in New York, New Jersey and Pennsylvania; 1818 to the West (Ohio, Indiana, Kentucky and Illinois). To enumerate all his publications would be a waste of time and paper.

François André Michaux (1770-1855) had already traveled with his father. In 1801 he started again for America, to explore the Western States. In June, 1802, he crossed the Alleghanies of Pennsylvania, on foot, descended the Ohio in a boat from Wheeling to Limestone; crossed Kentucky in a south-westerly direction, and Tennessee as far as Nashville, and returned via Knoxville in East Tennessee, to Charleston, S. C., where he arrived on the 18th of October, 1802.

After his return to France in 1803, he published his "*Voyage a l'Ouest des monts Alleghany's*," Paris, 1804. The book contains many valuable observations on vegetation, wild as well as cultivated. 1805, he published a work on the naturalization of North American forest-trees, and 1810-1813, his great work, "*Histoire des arbres forêstières de l'Amerique septentrionale*." There is an English translation, published in Philadelphia, 1859; *The North American Sylva*, three volumes, with 145 plates, uniform with Thomas Nuttall's work with the same title, published 1842-1854, which contains, in three volumes with 121 plates, those trees which are not described in Michaux's *Sylva*, mostly trees from the Rocky mountains, California and Florida, not known before.

Thomas Nuttall, a native of Yorkshire in England, and a printer by trade, came to America about the year 1808. He was, like Michaux, an indefatigable traveler. In company with John Bradbury, who had already explored the vicinity of St. Louis during the year 1810, he traveled, 1811, the Missouri upward to Fort Mandan; 1816, he was in the Alleghanies, in Kentucky and Ohio. On the 2d of October, 1818, he started from Philadelphia for Pittsburg, descended the Ohio to its mouth, then the Mississippi to the Arkansas river; this river upward to the Fort Smith; from there in a south-westerly direction to the Red river. After his return to Fort Smith, he followed the Arkansas farther up to the mouth of Verdegris river, and Grand river, and northward to the Osage saltworks. This latter excursion was full of hardships, disease, Indian pillaging and peril of life. Returning, he descended the Mississippi to New Orleans, where he arrived on the 18th of February, 1820.

From the manner of writing, we may often perceive the character of a man. Whoever may read his "Journal of travels into the Arkansas territory," published in Philadelphia, 1821, will be delighted at the plain, unpretending style, the "unvarnished tale," as he expresses himself in the preface, and will divine in Thomas Nuttall an amiable man.

In the years 1834 and 1835, Nuttall crossed the Rocky mountains to the Pacific coast, explored Oregon and California, made an excursion to the Sandwich islands, and returned around Cape Horn to the Atlantic coast. Besides the above-mentioned books, he published his "Genera of North American plants," in two volumes, Philadelphia, 1818; an "Introduction to systematic and physiological botany," Cambridge, 1827, and numerous descriptions of new plants, mostly in the Proceedings of the Academy of Natural Science, in Philadelphia. He died at the ripe age of seventy-three, on the 10th of September, 1859, in Lancashire in England.

Nuttall and Bradbury are mentioned by W. Irving in his *Astoria*, in which he describes the voyages of the parties sent out to Oregon by Mr. Astor. As both gentlemen left the expedition on the upper Missouri, these voyages had no further relation to botany.

Several other foreign botanists collected at that time in North America. Alire Raffénau Delile, professor of botany at the University of Montpellier, in France, after his return from the French Scientific Expedition in Egypt, a prominent member of which he was, came over to America and collected during three years, in the vicinity of Wilmington, N. C.

José Francisco Correa de Serra, secretary of the Royal Academy of Lisbon, came in the year 1813 to New York and Philadelphia, from where he made several excursions.

From 1817 to 1823 Mr. Milbert collected for the Museum of Natural History at Paris. He lived in New York and extended his excursions to the Ohio, Mississippi, Lake Superior and Canada.

Active American botanists of that time were Amos Eaton, professor in Albany, N. Y. He lived from 1776 to 1842, and published the first edition of his *Manual of Botany*, 1817, and of eight editions the last in 1841.

James Bigelow was professor of botany in Boston. His first edi-

tion of *Florula Bostoniensis* appeared in 1814, the third in 1840, and his *American Medical Botany*, 1817-1821, in three volumes with sixty colored plates.

William Baldwin, born in Pennsylvania 1779, collected in 1811, in Delaware, then in Georgia and Florida, and went, 1817, to Buenos Ayres, in South America. He died on the 31st of August, 1819, as a member of Major Long's first expedition, in Missouri. Darlington published, 1843, *Reliquiæ Baldwinianæ*. This expedition, by order of the Government, under the command of Major Long, started from Pittsburg in April, 1819, and proceeded the same year up the Missouri to Council Bluffs, where they wintered. Dr. Baldwin, the botanist of the expedition, sick already when the party set out from Pittsburg, died in Franklin, Mo., and Edwin James took his place, who compiled the account of the expedition in two volumes, 1823; the same year it was published in London in three volumes. The party started again on the 6th of June, 1820, from Council Bluffs, moved up the Platte river and examined the mountains from the South fork of the Platte to the Arkansas. Dr. James ascended the grand peak described by Major Pike in an account of his expedition in the years 1805-1807, which furnished no botanical matter. This peak is, in the narrative, called James' Peak; Fremont afterwards changed it to Pike's Peak, although Pike had only seen it and James was the first that ascended it. In returning, one part of the command followed the Arkansas river, the other the Canadian river. The catalogue of the collected plants, 500 to 600 species, was published by James, in 1825, in the *Transactions of the American Philosophical Society*, II, 172-190. James died 1861, near Burlington, in Iowa; he was born in Vermont, 1797.

In the period from 1820 to 1830 several *Floræ* of more or less limited parts of the United States were published. The best known are: *Botany of South Carolina and Georgia*, 1821-1824, in two volumes, with twelve plates, by Stephen Elliot, professor in Charleston, where he died 1830; the *Flora of the Northern and Middle States*, by John Torrey, 1824, and the *Flora Cestrica* (of Chester county, Pa.), 1826, by William Darlington, who lived from 1782 to 1863, and published the third edition of his *Flora* in 1853.

Lewis David v. Schweinitz, born in 1780 at Bethlehem, Pa., where he lived to 1834, published, in 1821, "*Specimen Floræ*

Americæ Septentrionalis Cryptogamicæ," containing the liverworts, and 1825, a Monograph of the genus *Carex*. He collected the fungi of Carolina, a catalogue of which, containing 1373 species, was published by Schwaegrichen, the well known cryptogamist, in Leipzig, 1822.

The catalogue of plants collected in the North-western territory during Major Long's second expedition, is written by Schweinitz. This expedition was described by Wm. H. Keating, the geologist of the party, and published in London in 1825, in two volumes, entitled, "Narrative of an Expedition to the Source of St. Peter's river, Lake Winnepeek, Lake of the Woods, etc., performed in the year 1823." The party left Philadelphia on the 30th of April, and the route of the expedition was the following: Wheeling, Fort Wayne, Chicago, Fort Crawford, Fort St. Anthony, up the St. Peter's river to its source, down the Red river to Lake Winnipeg, Rainy lake, Fort Williams on Lake Superior and return on the lakes. Edwin James was appointed botanist, but he missed the place of meeting, so Mr. Thomas Say, the zoölogist of the expedition, undertook to collect the plants. As several boxes containing collections, and dispatched during the expedition, were lost, the botanical collection was very poor, only 130 species. As poor as the collection was, the description of the species called new by Schweinitz, are mostly riddles not yet solved. So the expedition, otherwise interesting, was unimportant as to botany.

Dr. Douglass Houghton, who met, in 1845, a sad end by drowning in Lake Superior, was a member of Schoolcraft's Expedition to the sources of the Mississippi river in 1832, the narrative of which was published in 1855. He collected about 250 species of plants, only a few of which were new.

Up to this time a number of botanists were at work on the Pacific coast.

Adelbert Chamisso de Boncourt (1781-1838) and Frederik Eschscholtz (1793-1831) were commissioned by the Russian government, the one as naturalist, the other as physician, to the Russian Exploring Expedition in the Pacific and Behring straits, under the command of Kotzebue, 1815-1818, and explored Alaska and a part of the coast of California. The collections are partly in the royal herbarium at Berlin, partly in St. Petersburg.

The plants collected by Lay and Collie, of the expedition of

Capt. Beechey to the Pacific, 1825-1828, were described by Sir Wm. Jackson Hooker and G. A. Walker-Arnott, and published in London, 1841, a quarto volume with ninety-four plates. A part of these plants were collected in California.

Carl Heinrich Mertens, born in Bremen, 1796, took part in the Russian expedition under the command of Capt. Lütke, 1826-1829. Amongst his collections was a number of plants from the Island of Sitka, which, as Mertens not long after his return died in St. Petersburg, were described by Bongard in the memoirs of the Academy of Science of St. Petersburg, 1832. His account of the vegetation of Sitka was already published, 1827, in Berlin, by A. Chamisso, with observations of the same.

A member of the same expedition was F. H. v. Kittlitz, who published twenty-four fine landscape views of the Pacific islands and coasts, amongst which are four that give a good idea of the vegetative character of Alaska. Three of them are rather roughly copied in the U. S. Agricultural Report for 1868.

David Douglas, born in Scotland, 1790, traveled for the Horticultural Society of London. He arrived in July, 1823, in New York, made excursions through New York State to Canada, and returned to London 1824. The society was so well pleased with his collection that he was sent the same year to Oregon, where he arrived in February, 1825, on the same ship with Dr. John Scouler, another Scotchman, who was afterwards professor in Dublin, and died, seventy-two years old, in 1871, in Glasgow, his birthplace. Douglas took up his residence in Fort Vancouver, and made from there excursions into the interior of Oregon Territory, and to Northern California, then he crossed the Rocky mountains to the Athabasca river, and to York Factory on the shore of Hudson's bay. In October, 1827, he returned to England. In 1830 he undertook his second voyage to Oregon and Upper California, and in 1833 he crossed the Pacific to the Sandwich islands, where he lost his life in a horrible manner. It was on the 12th of July, 1834, that on an excursion he fell into a deep excavation made for the purpose of capturing wild beasts; a wild ox, plunging soon after him into the same hole, killed him. This was a time of disaster for traveling botanists. A year before Douglas, in February, 1833, Thomas Drummond died in Havana; two months only after Douglas, was Carl Beyrich taken away by the cholera at Fort Gibson, the next year Joseph Frank died in New

Orleans, and in 1837 H. B. Croom lost his life by shipwreck on the coast of North Carolina.

H. B. Croom was born in North Carolina, 1799; his catalogue of plants of Newbern, N. C., was, after his death, published by Torrey.

Joseph Frank came to America, 1835, and collected for a botanical society in Germany (the *Unio Itineraria*). He traveled in Pennsylvania, Ohio, Missouri and Louisiana.

Carl Beyrich, another German, was sent by the Prussian government. He collected, 1833, in North and South Carolina and Georgia 1300 species in one season. The next year he went with a military expedition (probably that of Col. Dodge) from St Louis to the Indian Territory, to leave it no more.

Thomas Drummond, brother of the well known Australian traveler, James Drummond, took part in Franklin's second expedition as an assistant of Dr. Richardson, in 1825. At Cumberland House he left the party to explore the Rocky mountains of the British Territory. In 1831 he collected in the Alleghanies, and then in the vicinity of St. Louis and New Orleans, where he embarked for Texas. He explored the country around Austin, Brazoria and Galveston, went to Apalachicola, in Florida, and started from there in February, 1833, for Havana, where he died in the month of March.

Already before Drummond, in 1827-1830 Texas was, in its more western parts, explored by Jean Louis Berlandier, from Geneva. He also, though later in 1851, died far from home in Matamoras, on the Rio Grande.

Maximilian, prince of Wied, traveled in the Western Territories in the years 1832-1834, and brought back to Germany a small collection of about two hundred species, which were published by Nees v. Esenbeck, professor of botany in Breslau. There was nothing new except the genus *Sarcobatus*, proposed by Nees and afterwards described again by Torrey under the name of *Fremontia*.

Many American botanists were at work in this period, collecting the plants about their homes or exploring the vegetation of larger districts. The most prominent ought to be named here: In Massachusetts, Bigelow, Tuckerman, Oakes, Dewey; in Connecticut, Barratt; in New York, Sartwell, Carey, Beck, Bailey; in Pennsylvania, Pickering, Durand and Darlington; in North

Carolina, M. O. Curtis; in Georgia, Boykin and Le Conte; in Florida, Chapman, Leavenworth and Blodgett; in Alabama, Gates; in Louisiana, Hale, Carpenter and Riddell, who, in 1835, published a *Flora of the Western States*, and afterward a *Flora Ludoviciana*. Other catalogues of local floras were compiled of the plants in the vicinity of Charleston, S. C., by Bachman, 1834; of the plants of Columbia, S. C., by Gibbes, 1835; of the plants near Baltimore, by Aikin, 1836. Dr. Pitcher collected in Arkansas, afterwards in Michigan; in Kentucky Dr. Peter and Prof. Short; in Illinois the same and Buckley; in Ohio, Lea and Sullivant; in Michigan, Wright; in Wisconsin, Lapham; in Missouri, Engelmann.

In the botany of the Californian survey, the first of which volume is now published, we find often the quotation of *Plantæ Hartwegianæ*.

Theodor Hartweg, a German gardener, was sent by the English horticultural society to Mexico and California, where he collected during the years 1838-1839. Many of the plants described and published by G. Bentham, under the above-mentioned title, in 1839-1848, occur in what was formerly the northern Mexican countries.

J. N. Nicollet, a Frenchman, employed under the Bureau of Topographical Engineers (since 1838), explored the basin of the upper Mississippi during the years 1836-1840. To his party was attached the German botanist, Carl Geyer, the large collections of whom were sent to Drs. Torrey and Gray. These two bright stars had already risen above the horizon of the botanical firmament, and commenced, at the close of the fourth decennium, their great work, the *Flora of North America*, opening a new epoch in the history of American botany.

The interest in the science of botany was now wide awake amongst the American public, and the Government bore its rich share of it, spending large sums for scientific purposes, by attaching scientific men to the nearly unbroken series of expeditions and surveys which were now undertaken.

771a *Extinct American Rhinoceroses and their Allies.* [December,
ON THE EXTINCT AMERICAN RHINOCEROSES AND
THEIR ALLIES.¹

BY E. D. COPE.

TWELVE species of mammals which may be called rhinoceroses, have been defined from materials obtained from the Tertiary formations of North America; and five additional species have been distinguished, which may be regarded as more or less nearly allied to that family. A few additional names have been proposed for supposed species whose characters are not yet established. In the corresponding formations of Europe and Asia, the fossil remains indicate a still larger number of species. The forms included in the family, first appear in both continents in the Lowest Miocene or Oligocene epochs; that is, in North America in the White River formation. The family still exists in Asia and Africa, but in Europe it disappeared during the glacial epoch. In North America it became extinct at a still earlier period, no remains of rhinoceroses having been found in beds of later age than the Loup Fork, or Upper Miocene period.

The genus *Hyracodon* (Leidy) which has a full series of incisor teeth, was formerly included in this family, and it agrees with the various genera in the structure of the molar teeth of both jaws. But I have ascertained that it differs so widely from them in some other respects, that it became necessary to regard it as the type of another family, the *Hyracodontidae*. The mastoid bone forms part of the external wall of the skull as in tapirs, and the neck is quite elongate. In fact the *Hyracodon arcidens* must have had the proportions of some of the horses in this respect. There is also no posterior tuberosity of the mandibular condyle, so conspicuous in the rhinoceroses.

The following table explains the relations of the two families:

- IV. Anterior exterior crescent of superior molars much reduced; inferior molars with cross-crests; superior molars and premolars alike, with cross-crests.
6. Mastoid bone forming part of the external wall of the skull; no postcotyloid tuberosity of the mandible; neck elongate.....*Hyracodontidae*
7. Mastoid bone excluded from the walls of the skull by the contact of the occipital and squamosal; a postcotyloid tuberosity of the mandible; neck short.....*Rhinoceriidae*.

The genera of *Rhinoceriidae* differ from each other as follows:

- I. Four anterior digits.
Incisors 2; canine 1; no horn; posttympanic bone distinct.....*Aceratherium*.

¹Adapted from a paper published in the Bulletin of the U. S. Geol. Surv. Terrs., Vol. v, No. 2, 1879.

II. ? Digits.

Incisors $\frac{1}{1}$; canine $\frac{1}{1}$; posttympanic bone distinct; an osseous tuberosity on each side the muzzle. *Diceratherium*.

III. Three anterior digits.

Incisors $\frac{2}{1}$; canines $\frac{1}{1}$; no horn; posttympanic bone distinct. *Aphelops*.

Incisors $\frac{1}{1}$; canines $\frac{1}{1}$; a dermal horn; posttympanic distinct. *Ceratorhinus*.

Incisors $\frac{2}{1}$; canines $\frac{1}{1}$; a dermal horn; posttympanic? *Zalabis*.

Incisors $\frac{1}{1}$; canines $\frac{1}{1}$; a dermal horn; posttympanic process coössified with postglenoid process; no nareal septum. *Rhinocerus*.

Incisors $\frac{1}{1}$; canines $\frac{1}{1}$; a dermal horn; posttympanic process not united with postglenoid; no nareal osseous septum. *Atelodus*.

Incisors $\frac{1}{1}$; canines $\frac{1}{1}$; a dermal horn; posttympanic coössified with postglenoid; an osseous septum dartum. *Calodonta*.

My catalogue of species of the above genera contains twenty-eight names, of which six belong to living species. The latter are *Ceratorhinus sumatranus* Cuv.; *C. lasiotis* Scl.; *Rhinocerus unicornis* L.; and *R. sondaicus* Cuv., all from Asia and Malaysia; and *Atelodus bicornis* L. and *A. sinus* Burch., of Africa. It is possible that a species of *Aphelops* still exists in some of the Indian islands, in the *Rhinocerus inermis* Less. There are probably several distinct fossil species not in the list; but their characters have not yet been sufficiently made known to enable me to refer them to their proper places. It will be observed that eight species have been found in North American formations, ten in European, and three in those of Hindostan. It appears also that no extinct species of the true genus of *Rhinocerus* has yet been found in North America or Europe, and that no extinct rhinoceros of North America which is known, possessed a median dermal horn.

It can readily be seen that the genera above defined form a graduated series, the steps of which are measured principally by successive modifications of four different parts of the skeleton. These are, first, the reduction of the number of the toes of the anterior foot; second, the reduction in the number and development of the canine and incisor teeth; third, the degree of closure of the meatus auditorius externus below; and fourth, in the development of the dermal horns of the nose and its supports. While these characters have the tangible and measurable quantities which render them available for generic diagnosis, there are others which possess a similar significance, and which I now notice, so far as they are observable in the extinct species of North America.

I premise by observing that the *Aceratheria* and *Diceratheria* of this continent have only been found in the eastern and western divisions of the White River formation, while the species of *Aphelops* are confined, so far as is known, to the Upper Miocene or Loup River formation.

The posttympanic process is, it is well known, well separated from the postglenoid process in the tapir, so as to leave the auditory meatus widely open below. The arrangement is similar in *Hyracodon*. In *Rhinocerus*, as shown by Flower, the meatus is closed below by the coössification of the two processes. In the oldest genus of the family *Aceratherium*, the relations of the parts are as in *Hyracodon*. In *Aphelops* the two processes approach each other, but do not come in close contact as in the genus *Ceratohhinus*.

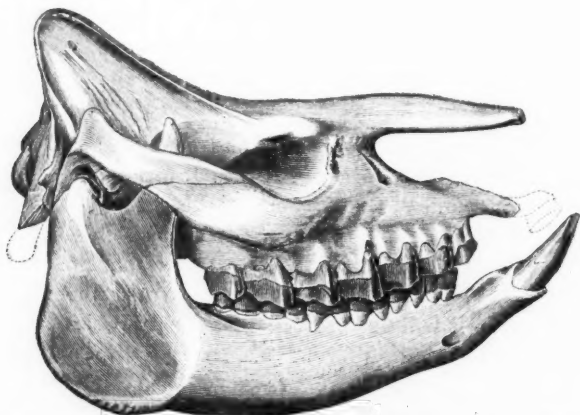


FIG. 1.—*Aphelops megalodus* Cope, one-sixth natural size. Loup Fork beds, Colorado.

The postglenoid process is low and transverse in the tapirs; in *Rhinocerus* it is long and has a triangular section. In some species of American *Aceratheria* its form is much like that of the tapirs (*A. mite*, *A. occidentale*); while in *Diccratherium pacificum* and in the species of *Aphelops*, the form of this process is as in *Rhinocerus*.

In the tapirs, the foramina sphenoorbitale and rotundum are distinct. They are also distinct in *Aceratherium mite*. In *D. pacificum* they are confluent, but the walls of their orifice present two opposite projections, which are the rudiments of a dividing septum. In *Aphelops* these foramina are one as in *Rhinocerus*. At the same time, the external wall of the alisphenoid canal is shorter and thinner in the *Aceratheria* than in the *Aphelops*.

In the older types of *Perissodactyla*, e. g., *Symborodon*, the foramen ovale is situated well in advance of the foramen lacerum medium, and is separated from it by a considerable space of the sphenoid bone. The same structure is seen in *Hyracodon* and in

Accratherium. In *Aphelops*, the foramen ovale approaches near to the f. lacerum, so as to be separated by a narrow bridge only in *A. megalodus*, which is wanting on one side in a specimen of *A. malacorhinus*. In the genus *Rhinocerus*, these foramina are not divided.

In the structure of the teeth, the same serial order is to be observed. Commencing with the incisors $\frac{3}{3}$ in the tapiroid types and *Hyracodon*, and canine $\frac{1}{1}$, we find $\frac{3}{2} \frac{0}{1}$ in *Zalabis*; $\frac{2}{1} \frac{0}{1}$ in *Aceratherium*; $\frac{2-1}{1} \frac{0}{1}$ in *Aphelops*; $\frac{1}{1} \frac{0}{1}$ in *Ceratorhinus* and *Rhinocerus*, to $\frac{0}{0-1} \frac{0}{0}$ in *Atelodus* and *Calodonta*. As to the molars, in those of the upper jaw the series of modifications consists of successive complication of the transverse crests. In *Hyracodon*, as in the tapiroid genera, the external wall of the posterior molar is

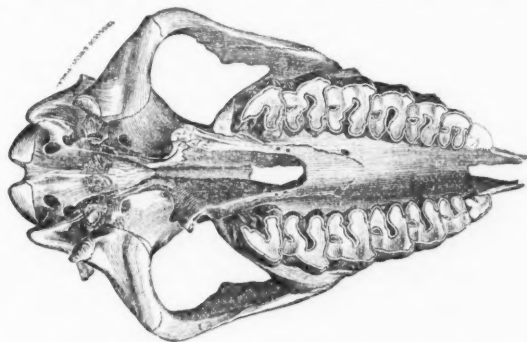


FIG. 2.—*Aphelops megalodus* Cope, inferior view of cranium represented in Fig. 1.

continued beyond the posterior cross-crest; in the *Rhinoceriæ*, generally the external wall is not continued beyond this crest, but is in line with the posterior cross-crest. In a specimen of *Accratherium occidentale*, the posterior superior molar of one side is like that of *Hyracodon*, while that of the other side is like that of *Rhinocerus*. The cross-crests in *Aceratherium* are quite simple, having slight bulges into the median valley. In the species of *Aphelops* these bulges are more prominent, especially that of the posterior crest, which is more externally situated than that of the anterior cross-crest, so that the fundus of the valley is turned abruptly backwards. In several of the existing species, this bulge becomes an antero-posterior crest, and the fundus is further divided by other crests from the outer wall and elsewhere. The cingula become so elevated as to cause an isolation of the valleys as fossæ at a comparatively early stage of wear. This

771e *Extinct American Rhinoceroses and their Allies*. [December, state of things commences in the extinct species of Kansas, the *Aphelops fossiger*.

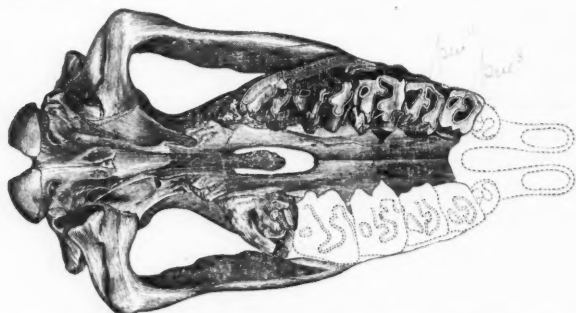
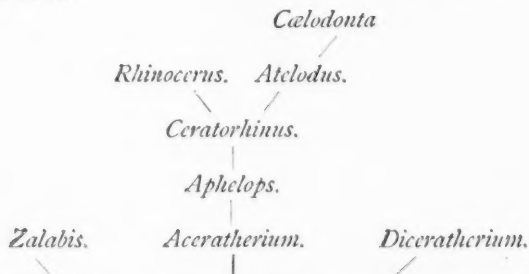


FIG. 3.—*Aphelops fossiger* Cope, skull from below, one-sixth natural size. Loup Fork beds of Kansas.

In the bones of the skeleton, modifications accompanying those of the cranium and dentition may be observed. The femur of the species of the earlier formations may be readily distinguished from that of those of the later Tertiaries by the forms of both the extremities. In the *Aceratheria* this bone resembles that of the tapirs in the form of the great trochanter. This process is produced at its external border, has a recurved apex, and encloses a deep trochanteric fossa. In *Aphelops* it is precisely as in *Rhinoceros*, obliquely truncate externally, without prominent apex or well marked fossa. In the *Accratheria* the inner crest of the rotular groove is but moderately prominent; in *Aphelops* and *Rhinoceros* it is greatly developed.

The succession of development of the line of the *Rhinoceridae* is now not difficult to trace, and I give the following diagram in explanation of it.



It is evident that the descent diverged at a comparatively late period of geological time into two lines, which are represented at the present day by the African and Indian species respectively.

The earliest species of the toothless or African series is the *Atelodus pachygnathus* of Wagner, whose characters have been so well worked out by Gaudry in his great work on the Fossil Fauna of Attica. That species sometimes presents a single small incisor or canine tooth in the mandible.¹ From what has preceded it is also apparent that the generally most specialized type of rhinoceros, the genus *Cœlodonta*, has become entirely extinct. Its three species yet known, were confined to Europe and Northern Asia, and the most formidable of them extended its range with the hairy mammoth within the Arctic circle. The *Cœlodonta antiquitatis* (the woolly rhinoceros) was evidently the most effectively armed of the family, as it had two horns, which, judging from the character of the surface of the skull to which they were attached, must have been of unusual size. To provide further against the shocks incident to their use in combat, the narial septum was ossified, thus becoming a solid support to the nasal bones, etc., on which they stood.

It remains to look backwards, and to discover, if possible, the probable origin of the family in that of its earliest known genus, *Aceratherium*. A late survivor of this ancestral type is seen in the genus *Zalabis* Cope, of which one species, the *Z. sivalensis*, has been discovered by Cautley and Falconer in the late Tertiary of Hindostan. In this form, according to Falconer, there are $\frac{3}{2}$ incisors and $\frac{1}{2}$ canines. The early type, which corresponds most nearly with this genus, and which preceded the *Aceratheria* in time, is the genus *Amynodon* Marsh, which has left a species in the Uinta or Upper Eocene of Utah. Here the incisors are $\frac{3}{2}$ and the canines $\frac{1}{2}$. This formula is intermediate between that of *Aceratherium* and that of the Eocene tapirs, where the normal numbers $\frac{3}{2}$ $\frac{1}{2}$ prevail. According to Marsh, *Amynodon* further differs in the primitive condition of the premolars above, which, as in the *Lophiodontidae*, differ from the molars in their greater simplicity. Thus it is probable that tapiroid animals, probably *Lophiodontidae*, gave origin to the *Rhinoceridae*, as Marsh has suggested. And it is further altogether probable that the general type of dentition presented by the *Rhinoceridae*, *Lophiodontidae*, etc., which I have named the palæotheriodont, took its origin from the type which is intermediate between it and the bunodont, viz: the symborodont, as I have pointed out in an essay on this subject.²

¹ The large tooth of the mandible described by the older authors as an incisor, has been regarded as a canine by Gervais. Subsequently Marsh adopted the same view.

² The Homologies and Origin of the Molar Teeth of Mammalia, etc. Journal Academy Nat. Sciences, Philada., 1874, pp. 13-14.

The first appearance of dermal horns was apparently in a pair placed transversely on the nasal bones, in species of Eocene *Lophiodontidae*, of the genus *Colonoceras*. The same character has been observed by Duvernoy in species of the Lower Miocene, which belong to the true *Rhinocerotidae*, and which Marsh has called *Diccratherium*. This genus appears to have terminated the line exhibiting this structure, and the family in North America remained without horn. As we have seen, the types possessing the median horn arose in Europe, in the *Ceratorhinus schleiermacheri* of the Middle Miocene, and still survives.

It may be observed in conclusion, that a successive increase of size in the species of this line has taken place in North America with the advance of geologic time. Thus, their probable ancestors of the genus *Hyrachyus* were the least of all. The *Acera-*

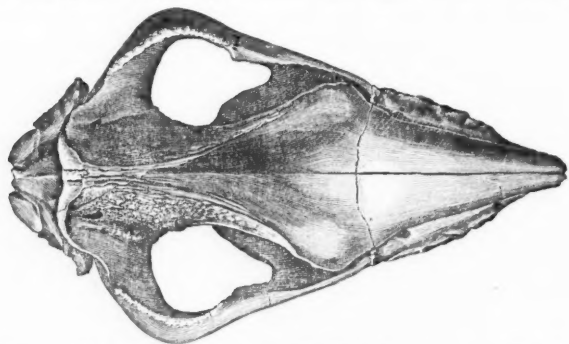


FIG. 4.—*Aphelops megalodus* Cope, skull from above (same as FIG. 1), one-sixth natural size.

theria of the White River formation were larger, the oldest, *A. mite*, being the smallest. The *Diccratheria* of Oregon were larger still. The species of the Loup River or Upper Miocene formation were larger, and nearly equal to the large existing species.

Accratherium Kaup. is characteristic of the Miocene or Middle Tertiary formations of Europe, and is the primitive form of the true rhinoceroses. Its four anterior digits relate it to the lower or more generalized perissodactylous types of the same and of older geological horizons, which are equally allied to the tapirs. The dentition differs from that of the genus *Rhinoceros* in the presence of two superior incisors, but agrees with it in the existence of one incisor and one canine on each side below, and in the forms of the premolar teeth. The species display great simplicity in the character of the crests of the molars. They also possess

the tapiroid feature of the non-closure of the auditory meatus below by the posttympanic process; and the postglenoid process is generally more like that of the tapirs than are those of the later genera *Aphelops* and *Rhinocerus*. The form of the femur is also quite characteristic, presenting tapiroid characters again in the shape of the great trochanter. This process is not flat and obliquely truncated as in the genera above named, but is horizontal proximally, and with a produced recurved apex and posterior crest, which bound a large fossa. The species are the smallest of the family, the *A. mite* having the dimensions of the Malayan tapir.

In the species of *Diceratherium* (Marsh) the cranium and limb bones present the characters above ascribed to the *Aceratheria*. In size they are intermediate between the latter and the *Aphelops*. The two American species are known from the beds of the Truckee epoch of Oregon; a third species, *D. pleurocerus* (Duv.) has been found in France.

Aphelops (Cope) occupies a position intermediate between *Aceratherium* Kaup and *Rhinocerus* Linn. It agrees with the former in the presence of incisor and canine teeth, and in the absence of indication of a nasal horn, but differs from it in lacking the fifth digit of the anterior foot. In the last respect it is identical with the genus *Rhinocerus*, differing from it in characters already mentioned, in which it agrees with *Aceratherium*. From *Atelodus* Pom. it differs still more widely, as that genus wants incisor and canine teeth.

The evidence on which this genus rests is furnished by two species, the *Aphelops megalodus*, and the *A. fossiger*. In both of these animals, the number of anterior digits is known to be only three and in the former the inferior canines and alveoli for incisors can be seen in the specimens. In two other species provisionally referred to the same genus, the *A. crassus* and *A. malacorhinus*, the

digits and incisor teeth are unknown but the last named species was certainly hornless, and it is supposed that the first named was



FIG. 5.—*A. megalodus* figured above, posterior view of skull.

FIG. 6.—*A. fossiger*, skull figured in Fig. 3, one-sixth natural size.

so also. Of the many mandibular symphyses from the Loup Fork formation which I have seen, none lack the canines and incisor teeth, so that it is probable that this character belonged to the two species above mentioned. A fifth species, the *A. meridianus* Leidy, I have provisionally referred here, on account of the similar character of the mandibular dentition; but its nasal bones and feet are unknown. Still another species, the *A. jemezianus* Cope, has been referred here, but on no other ground than that it is found in the same formation as the others.

Specific characters.—The species above named all present well-marked cranial or dental characters, or both. But it is important to take into consideration the general structure of the skeleton. I am in position to do this with three of the species named, the



FIG. 7.—*Aphelops malacorhinus* Cope, skull one-sixth natural size, restored behind from another cranium.

A. megalodus, the *A. fossiger* (of this paper), and the *A. malacorhinus* and find distinctive characters present in nearly all their bones which I have observed. The *A. malacorhinus* is a comparatively long-limbed animal, and its apparent elevation was increased by the shortness of the body, and especially of the neck. There was probably a great development of the upper lip, or snout, and the face was concave in profile. The *A. megalodus* was somewhat intermediate in proportions between this species and the *A. fossiger*. Its limbs were shorter than in the *A. malacorhinus*, and the neck was longer. The feet were more slender. The *A. fossiger* had still shorter legs, and the length of the neck was about as in *A. malacorhinus*. In its form it must have been like a *Hippopotamus*. Its limbs, and especially the feet, were very robust.

Position.—The longest known species, the *A. crassus*, was found by Dr. Hayden on the Niobrara River, Nebraska. Teeth presenting the same characters have been found in Northern Kansas and Eastern Colorado. The other species are more restricted geographically. A considerable exploration in the Loup Fork beds of North-eastern Colorado, conducted by myself in 1873, yielded four individuals of *A. megalodus*, but no fragments referable to the other species. Explorations in Northern Kansas by Russell S. Hill, of Philadelphia, produced five individuals of *A. fossiger* and five of *A. malacorhinus*, but not a fragment of *A. megalodus*.

History.—In my original definition of this genus, I relied on

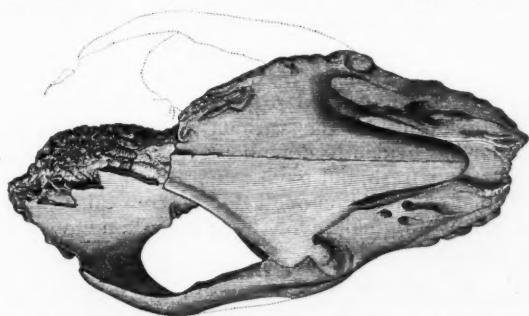


FIG. 8.—*A. malacorhinus* skull, represented in Fig. 7 from above, one-sixth natural size.

the number of premolars in distinguishing it from *Rhinoceros*, as well as on the absence of the horn. These teeth are generally $\frac{3}{4}$ in *Aphelops*, and are said to be $\frac{4}{5}$ in *Rhinoceros*, in most works on the subject. These numbers are not constant; on one side of both jaws in *Aphelops* from Colorado, I have observed a first premolar, and on one side of the upper jaw of *A. malacorhinus* there are four premolars; the other side is injured. In several species of *Rhinoceros*, three premolars only are usually found in the mandible. I may add that Lesson and Peters¹ have described a *Rhinoceros inermis* Less., which is found living on some of the islands at the mouth of the Ganges. The only known specimens are the skulls, with portions of the skin, of a female and young. These are hornless, and in general structure allied to the *R. sondaicus*, yet presenting some important differences.² Should the characters of this form prove to be specific, and the male be found to lack the horn, it must be regarded as a species of *Aphelops*.

¹ Monatsberichte Berlin. Akademie, 1877, p. 68, pl. 1-2.

² Peters represents the posttympanic as not coössified below the meatus as in *R. sondaicus*.

RECENT LITERATURE.

PAGENSTECHER'S GENERAL ZOÖLOGY.¹—The third part of this work was only received during the past summer, and though the fourth part is promised for the present year, we will not wait for its appearance before calling the attention of our readers to what appears to us a most valuable work of reference. It is planned somewhat differently from other zoölogical manuals, being written mainly from the side of comparative anatomy. The first part is divided into three books, the first being introductory, the second treating of the nature of animal bodies in general, this caption including a discussion of individuality and pleomorphism; while the third book treats of the subdivisions of the animal kingdom, with a free discussion of the doctrine of species. The second part appeared in 1877, and treats of the organization and functions of animals, the entire part being devoted to the organs of digestion and nutrition, and of circulation. The third part treats of respiration chiefly from an anatomical point of view, giving in 419 closely printed pages an account of the different modes of breathing in the various groups of animals. Prof. Pagenstecher has evidently done his work carefully. The woodcuts are new and fresh, but often rather too small and indistinct, not quite diagrammatic enough for anatomical drawings, still they are mostly original, involving a large amount of work on the part of the author.

HARVARD LIBRARY CATALOGUE OF SERIALS.²—This most useful publication grew out of the efforts of the author to bring about some degree of coöperation between the different libraries in and about Boston, by which valuable and costly works should not be duplicated, but that each library should aim to complete their series of works in separate departments. As the first step in this important reform was the preparation of a bibliographical list of all scientific serials, whether those now in course of publication or not, the labor was entrusted to Mr. Scudder, who has brought a special aptness and zeal to such work, together with an exactness and care in treatment characteristic of all his writings. As it stands, the volume will be in constant use by the naturalist, since the serial literature of biology and the natural sciences generally has now assumed enormous proportions.

The catalogue comprises a list of the serial publications of each country, the towns or places of publication being arranged

¹*Allgemeine Zoölogie oder Grundgesetze des thierischen Baues und Lebens.* Von H. ALEXANDER PAGENSTECHER. Theil 1-3. Berlin, Verlag von Wiegandt, Hempel & Parey, 1875-1878. 8vo, with 433 woodcuts.

²*Library of Harvard University. Special Publications.* I. Catalogue of Scientific Serials of all Countries, including the Transactions of Learned Societies in the Natural, Physical and Mathematical Sciences. 1633-1876. By SAMUEL H. SCUDDER. Cambridge, Library of Harvard College, 1879. 8vo, pp. 358.

alphabetically under each country. The index is subdivided into an index of towns, of titles and of minor subjects, such as anatomy, anthropology, botany, entomology, geology, &c., &c. A considerable amount of bibliographical information is given under the different titles, of much importance in treating of synonymy. The work will hereafter stand on the shelves of the naturalist's library side by side with Agassiz's *Bibliographia Zoologica*, Engelmann's *Bibliotheca Historico-Naturalis*, Carus and Engelmann's *Bibliotheca Zoologica*, Hagen's *Bibliotheca Entomologica*, supplementing these valuable works. It is gratifying to notice the appearance of such works as this and Coues' *Bibliography of Ornithology* in this country, as evincing the richness of American libraries in scientific works, and the number of those who use them with discernment.

We have no criticisms to make on the volume, as the arrangement seems to be all that could be desired. Doubtless, errors will be found upon using it, and the compiler invites criticism and the communication of errors, that they may be corrected hereafter. This is the first instance, so far as we now recollect, of the issue of such important and generally useful works by any library, and due credit should be given to the university whose librarian had the public spirit and enterprise to undertake the publication of such an expensive work without a special fund for such purposes.

ZITTEL'S HANDBOOK OF PALÆONTOLOGY.¹—This will, when completed, be without doubt a most useful compendium of the subject, though to be authoritative a work on palæontology should, we think, be written by one who has been more active as a zoölogist than the talented author. The first part begins with a general history of the rise of palæontology and a statement of the subject in general, and the second *lieferung* carries us as far as the Echinodermata, *i. e.*, through the Cœlenterata, the latter including the sponges.

We notice that in the first *lieferung*, which was published in 1876, Bathybius is admitted to be an organism, as is the Eozoön.

In the second volume, of which the first *lieferung* has appeared, Prof Schimper treats of the fossil plants, beginning with the Diatoms and nearly completing the account of the ferns. Both authors treat their respective kingdoms alike, *i. e.*, in an almost purely systematic way, diagnoses of the classes, orders and genera being given, often with descriptions of the species.

The illustrations are numerous and usually excellent, but often on too small a scale, a fault of Pagenstecker's work, and of many German books, the woodcuts of Gegenbaur's *Elements of*

¹*Handbuch der Palæontologie.* Unter mitwirkung von, W. PH. SCHIMPER. Herausgegeben von Karl A. Zittel. Band I. Lief. 1, 2, 3. Band II. Lief. 1. München, 1876-79. 8vo.

Comparative Anatomy being a notable exception. This palæontology will consist of two volumes, and will, when completed, be a valuable work of reference, though almost entirely based on European forms.

MISS BALLARD'S INSECT LIVES.¹—This attractive little book deserves commendation from the fact that the authoress has evidently the zeal of a genuine naturalist, has studied insects in the field and closet, and describes what she has seen in a clear and admirable manner. The first and best lesson in the study of insects is the rearing of a butterfly from the egg; one learns more of entomology in this than by any other method. This book will, we feel sure, induce boys and, we hope girls to gather caterpillars and rear butterflies just for the fun of the thing, while unconsciously they will be learning valuable lessons in observing natural objects. We have no fault to find with the illustrations, which are beautiful, and generally, when original, accurately, as well as artistically drawn, while those which are copied from the best entomological artists, are faithfully done; some, however, are evidently electrotypes from Harris, Riley, etc. We notice an error on page 11. The spinneret, in caterpillars, is situated on the *under* not the *upper* lip, the silk glands passing into the floor of the mouth and opening through the labium. We heartily endorse the advice to those beginning the study of insects that "we should not begin with statistics—studying how many thousands of moths and butterflies there are supposed to be, or how many species of insects have been classified and named. Take 'one to begin,' as children say, and study it thoroughly."

GRABER'S INSECTS.²—We have already drawn attention to the first two parts of this admirable work, and the commendations then bestowed upon it will apply to the present part. The biology of insects is concluded by chapters relating to the reproductive habits of insects, parthenogenesis and certain anomalous modes of reproduction, and to their powers of destruction. The author evidently belongs to the German ultra-Darwinian materialistic school, and claims, to use his own words, that: "It is the grand, free idea of the present age, which acknowledges the existence outside of and above nature of no power *and in general no being*, that all existing, all physical and psychical phenomena may be explained by the active causes in nature, and that the individual is not necessary for the preservation and harmonious develop-

¹*Insect Lives, or Born in Prison.* By JULIA P. BALLARD. Cincinnati, Robert Clarke & Co., 1879. Sq. 12mo, pp. 97. \$1.00.

²*Die Naturkräfte.* Eine naturwissenschaftliche Volksbibliothek. XXII Band, 2 Hälfte. Die Insekten. Von Dr. VITUS GRABER. II Theil, 2 Hälfte: Vergleichendes Lebens und Entwicklungsgeschichte der Insekten. Mit 127 original holzschnitten. München, Druck und Verlag von R. Oldenbourg. 1879. 3 marks.

ment of the whole, but all unitedly produced as the resultant of the coöperation of the individual powers of nature."

It is easy for the Austrian professor to give utterance to this dogma, but in the present state of our knowledge we doubt whether such a broad generalization (or narrow conclusion) can be supported by demonstrable facts, and we would urge that, as in human history so in that of the lower animal world, individual effort is all important; the success of certain favored individuals effecting and insuring a progress that ultimately dominates the whole mass of organized beings.

The instances which the author gives of the losses from insect depredations are of a mild order compared with those sustained in the United States, but on the whole the subject is treated in a comprehensive and interesting way. The illustrations of this part, though sometimes too diminutive and not always carefully engraved, are perhaps sufficiently clear for a popular work.

The last part is devoted to the embryology and metamorphoses of insects, and forms a fresh, well illustrated and most convenient treatise on the subject. The works of Weismann, Kowalevsky and others are freely used, and a good deal of valuable original matter introduced; the application of the germ-layer doctrines to insects, the novel illustrations of the embryology of different insects, in which work the author's former experience as a histologist and entomologist has made him an adept, and the schematic drawings to illustrate the process of molting, and the formation of the pupa under the skin of the larva, these and other points appear to have been elaborated with a briefness and clearness of treatment which, with the previous anatomical part, will render the work a standard one for some years to come. Among the illustrations of hitherto unpublished embryological facts are cross sections of the embryo of the flesh fly, of the *Lina populi* beetle, the two diagrammatic drawings of the germ and its embryonal layers; of the embryo of Mantis, and the eggs of the swarm-moth (*Liparis dispar*). The author has attempted to combine the results of different embryologists, and to clearly expound them for the use of the general student in a way which has not hitherto been accomplished. The portion on the metamorphoses of insects is treated in a way not wholly new to the American reader, but the matter, some of which is new, and the valuable and original figures of the longitudinal section of the puparium and enclosed pupa of a muscid fly, the section through the thorax of a *Polistes* wasp, through the head of a caterpillar, and through the thorax of the cabbage-butterfly are original and valuable.

RECENT BOOKS AND PAMPHLETS.—The Genera of European Nemerteans critically revised, with description of several new species. By Dr. A. A. W. Hubrecht. (Note XLIV of the Leyden Museum. 8vo, pp. 193-232.) From the author.

Darwinism and other Essays. By John Fiske, M.A., LL.B., etc. 8vo, cloth, pp. 283. Macmillan & Co., London and New York, 1879.

Verlaufige Resultate fortgesetzter Nemertinen-Untersuchungen. Von Dr. A. A. W. Hubrecht. 8vo, pp. 3. (Ext. from Zoologischer Anzeiger, August, 1879.) From the author.

On the Extinct Species of Rhinocerotidae of North America and their allies. By E. D. Cope. 8vo, pp. 227-237. (Ext. from the Bulletin of the U. S. Geol. and Geog. Surv., Vol. v, No. 2.) Washington, Sept. 6, 1879. From the author.

Notices Géologiques et Paléontologiques sur les Alpes Vaudoises et les régions environnantes. Par E. Renevier, Professeur. 8vo, pp. 395-409. (Ext. from Bull. Soc. Vaud. Sc. Nat., xvi, 82.) Sept., 1879. From the author.

L'Archæopteryx macroura, un intermédiaire entre les oiseaux et les reptiles. Par M. C. Vogt. 4to, pp. 241-248. (Ext. Rev. Scientifique, 13 Septembre, 1879.) (An address before the Congress of Swiss Naturalists at Saint Gall.) From the author.

On Lithophane and New Noctuidæ. By A. R. Grote. 8vo, pp. 201-208. (Ext. from Bull. U. S. Geol. and Geog. Surv., Vol. v, No. 2.) Washington, Sept. 6, 1879. From the author.

Geological Survey of Hakkaido—Geological Maps: (1.) Of a rough Survey of the Kayanoma Coal Fields in Yesso, Japan. By Benj. Smith Lyman, chief geologist and assistants. May, 1876. (2.) Map of Eastern Asia, to show the commercial position of the productive Coal Fields of Yesso, Japan, compiled from various sources. By the same. May, 1876. (3.) A Geological and Topographical Map of a rough Survey of part of the Nuppaomayai Coal Field in Yesso, Japan. By the same. May, 1876. (4.) A Geological and Topographical Map of a rough Survey of part of the Bibai Coal Field in Yesso, Japan. By the same. April, 1876. From the author.

Palæontological Papers, No. 11: Remarks upon certain Carboniferous Fossils from Colorado, Arizona, Idaho, Utah and Wyoming, and certain Cretaceous Corals from Colorado, together with descriptions of new forms. By C. A. White, M.D. 8vo, pp. 209-221. (Ext. from Bull. U. S. Geol. and Geog. Surv., Vol. v, No. 2.) Washington, Sept. 6, 1879. From the author.

Description de quelques poissons d'espèces nouvelles de la collection du Museum d'histoire Naturelle. Par M. H. E. Sauvage. 8vo, pp. 9. (Ext. du Bull. de la Soc. Philomathique de Paris, séance du 12 juillet, 1879.) From the author.

Notes on the habits of the Great Northern Shrike. By D. M. Marshall. (In the Journ. of Science, N. Ser., Vol. 11, No. 6, August, 1879.) Toledo, O. From the author.

The Autopsy of an Elephant. By A. J. Howe, M. D. (Read before the Cincinnati Soc. of Nat. History, May 6, 1879.) 8vo, pp. 8. From the author.

On Certain Remarkable Groups in the Lower Spectrum. By Prof. S. P. Langley. 8vo, pp. 92-105, pls. 3. (Ext. from Proc. Amer. Acad. Presented Oct. 7, 1878.) From the author.

On the Temperature of the Sun. By Prof. S. P. Langley. 8vo, pp. 106-114. (Ext. from Proc. Amer. Acad. Presented Oct. 9, 1878.) From the author.

Foot-prints of Vanished Races in the Mississippi valley; being an account of some of the monuments and relics of prehistoric races scattered over its surface, with suggestions as to their origin and uses. By A. J. Conant, A.M. Large 8vo, pp. 122. Chancy R. Barns, St. Louis, Mo., 1879. From the publisher.

The Gardener's Monthly and Horticulturist, Vol. xxi, No. 248. August, 1879. From the publisher.

Monthly Weather Review, July, 1879. (General Weather Service of the United States.) 4to, pp. 8, 4 meteorological maps. From the War Department.

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Report of the Entomologist, Charles V. Riley, M.A., Ph.D., Aug. 22, 1879. 8vo, pp. 52, pls. vii. (Ext. from the Ann. Report of the Dep. of Agriculture, 1878.) From the author.

Chicago Field, Vol. xii, No. 8, Oct. 4, 1879. From the editor.

On the Structure and Affinities of the "Tabulate Corals" of the Palaeozoic Period, with critical descriptions of illustrative species. By H. Alleyne Nicholson, M.D., D.Sc., F.R.S.E., etc. 8vo, cloth, pp. 342, pls. I-XV. W. Blackwood & Sons, Edinburgh and London, MDCCCLXXIX.

Suggestions on the Maintenance, Creation and Enrichment of Forests, as applicable to the particular requirements of the colony of Victoria. By Baron Ferd. Von Mueller, F.R.S., etc., government botanist for Victoria. 12mo, pp. 31. Melbourne, 1879. From the author.

The Geological Survey of the Fortieth Parallel. By Prof. J. S. Newberry. 8vo, pp. 16. (Repr. from Pop. Sci. Monthly, July, 1879.) From the author.

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GENERAL NOTES.

BOTANY.

ON THE HABITAT OF RHODODENDRON CATAWBIENSE.—In the spring of 1878 I was informed that "laurel" grew in abundance a few miles from the State University, at Chapel Hill. As I was at that time unfamiliar with the flora, having but recently removed to North Carolina, my first thought suggested a species of *Kalmia*. In April I visited the locality—the northern exposure of a steep bank on Morgan's creek, some three miles from the village. Much to my surprise I beheld a dense growth, not of *Kalmia*, but of *Rhododendron*. The shrubs were from eight to fifteen feet in height and among the smooth green leaves were clusters of the most beautiful purple blossoms. Could it be *Rhododendron catawbiense* growing so luxuriantly at an altitude of only five hundred feet? I sent specimens to my friend, Prof. W. R. Dudley, of Cornell University, together with a description of the locality. In reply to my letter, he says: "I recognized them at first sight as this (*R. catawbiense*). * * They are indigenous only on the higher summits of the Alleghanies. We found them on the Black mountains last summer, but only above 6000 feet." Up to this time, I must confess, I had been somewhat in doubt as to the species, especially as the plant occurred in such an unusual situation, but after submitting specimens to so competent a botanist as my friend, who had studied the *Rhododendron* in its mountain home, all doubts were removed. Last spring a member of the university chancing to meet Prof. Gray, who was on a botanical excursion in Western Carolina, mentioned to him the fact that the laurel grew near Chapel Hill. Dr. Gray was evidently much astonished, and, having been informed of this, I immediately sent him a dried specimen and a description of the locality. He replied as follows: "The laurel (which I had heard of from one of your pupils whom I met in June) I am delighted to see. It is certainly, as you say, *R. catawbiense*, and most remarkable for occurring at so low a level, where it flowers early. It comes down somewhat as *R. punctatum* does in

Georgia. But this is *more remarkable*.¹ It seems strange that the growth of this plant in the middle region of the State should have escaped the notice of that acute observer, the Rev. M. A. Curtis. That it did will be seen from the following, taken from his catalogue:²

"*Oval-leaved Laurel* (*R. catawbiense* Michx.).—This splendid laurel is chiefly confined to the highest summits of our mountains, but is said to extend somewhat into Virginia. It is often confounded with the preceding [*R. maximum* Linn.], but besides its different locality, growing only on the tops of such mountains as the Roan, in Yancey, and Negro Mt., in Ash, it blossoms earlier than the other, though at a higher elevation, has larger and more intensely colored flowers, and shorter and broader leaves. * * * * It stands cultivation pretty well in the middle district."

Since the above correspondence I have been informed that this plant grows luxuriantly on the north side of the Oconee mountains (hills from two hundred to three hundred feet high), near Hillsboro, the home of the late Dr. Curtis, at an altitude of from seven hundred to eight hundred feet. Not only does it stand cultivation in the middle district *where it is indigenous*, but it seems to thrive in the lowland of the eastern part of the State. Plants may be seen at Tarboro, in Calvary churchyard, where they were planted many years ago by my friend, the Rev. Dr. Cheshire.—*Prof. F. W. Simonds, University of North Carolina.*

THE TWINING OF THE STEMS OF THE HEDGE BINDWEED, ETC.³—Several plants of *Calystegia sepium* (hedge bindweed) were faithfully studied, for some weeks, by S. W. Beaumont. It is generally stated that the stems of this plant ascend by coiling against the sun, or from right to left, as viewed from the outside. On a stalk of nettle were observed two vines twining in opposite directions.

By tracing these two vines, they were found to preserve their opposite directions for their entire length. Another plant had two branches starting near the root. Each of these branches, and every branch on these divisions throughout, preserved the same course. This was also found to be the case in a vine twining in an opposite direction. Experiments to induce vines to reverse their course proved of no avail. Straight stakes were placed in the ground for the vines to twine about. After arriving at the top, the vines fell or lopped over; some drooping slightly, some ascending. If the top of a plant is weak, the vine often leaves it before reaching the top. Sometimes the vine becomes

¹ Dr. Gray has kindly added a note on this point to an article in the Bulletin of the Torrey Botanical Club for July and August, 1879. See page 336.

² The Woody Plants of North Carolina, Raleigh, 1860, p. 97.

³ Abstracts from papers of students of Michigan Agricultural College, made by Professor W. J. Beal.

twisted, but not always. The vines are quite slender, and often reach off from their support to a great length. One branch reached four feet and six inches, nearly in a horizontal position; another, five feet and three inches; another, nearly six feet. This last, like the rest, was a single vine, and at the largest place only a sixteenth of an inch in diameter. One branch, which reached out twenty inches, passed over a sixth of the circumference in three-quarters of an hour. Sometimes the vines can almost be seen to move. They appear to move most rapidly in the hottest part of the hottest days.

Mr. T. F. Millspaugh experimented with wild cucumber (*Echinocystis lobata*). He trained a plant on a straight upright stake. The vine grew erect until it was about fifteen inches above the stake, and then bent over at about an angle of 45 degrees. It gradually dropped to a horizontal position and grew four feet and nine inches beyond the stake. Then it turned, and began to grow back on itself down to the stake. Here it neither went up nor down, as we should suppose, but grew right on the other side of the tip of the stake, till, at the time of writing, it had gone twenty inches. Before the vine doubled back on itself it described a complete circle in one hour and forty-five minutes. It went fastest on one hot day, between one and three o'clock. Tendrils were made to coil by irritation of various objects. He examined fifty specimens of tendrils which had made coils. It is well known that when these become attached at the extremity, that they turn in one direction for a part of their course, and then turn in the opposite direction. In one tendril there were seven of these changes in direction; in two there were six changes; in six there were five; in eleven there were four; in twenty-three there were three; in five there were two, and in two there was one change.

BOTANICAL NEWS.—The *Bulletin* of the Torrey Botanical Club, for July and August, contains interesting notes of a botanical excursion into North Carolina, by J. H. Redfield, to which Prof. Gray contributes foot-notes. The discovery of *Epipactis helleborine*, var. *viridans* Sim., in the vicinity of Syracuse, N. Y., by Mrs. Church, a member of the Syracuse Botanical Club, is recorded. To the September number Mr. C. F. Austin contributes some bryological notes.—In the *Botanical Gazette* for October, Prof. Gray draws attention to Poisson's account of the beheading of flies by *Mentzelia ornata*, the victims being caught in the barbs of this plant. The flies, attracted by the viscid matter in certain of the bristles, "thrust in their proboscis between the thickly set glochidiate bristles to feed upon the secretion of the glands between and below. The retrorse barbs interpose no obstacle to this; but when the proboscis is withdrawn, its dilated and cushion-like tip catches in the barbs, and holds all fast. The harder

the backward pull, the firmer and the more extensive the attachment to the sharp barbs; the wounded and impaled organ becomes congested and swollen, and the insect is seldom able to disengage it. Especially is this the case with the larger flies. Some perish by exhaustion, but more of them, passing round and round in a circle and in one and the same direction, come to an end by twisting off their heads!"—Trimen's *Journal of Botany* for October, gives us a note on borage, by H. F. Hance, of interest to American botanists.—Prof. P. von Tieghem has succeeded Brongniart as Professor of Botany at the Museum at Paris.—In Caruel's *New Italian Botanical Journal*, is an article on the morphology and biology of freshwater algæ allied to Nostoc, etc., by A. Borzi.

ZOOLOGY.¹

NOTES ON SOME REPTILES AND BATRACHIA OF THE PACIFIC COAST.—The large frog (*Rana temporaria* var. *aurora*), sometimes called "bull-frog," of this coast is eaten in considerable quantity in San Francisco. Its consumption is not confined to Frenchmen, at whom some rude people are apt to scoff as "frog-eaters," but extends to some individuals of the beef-eating nation, as well as to Americans and those of other nationalities.

The real bull-frog is much larger than our species, yet a large specimen of the latter reaches the very respectable length of five and a-half inches from the nose to where the tail of his tadpole days commenced. Such large frogs are by no means cheap delicacies, since they are retailed at four dollars per dozen. The smallest I have yet seen in the market were worth one dollar and seventy-five cents per dozen. And there is reason for the high price.

Ponds and brooks margined or partly overgrown with water-weeds, such as frogs love, are scarce in the vicinity of San Francisco, and most of those which occur have been to a great extent depopulated of their croaking inhabitants long ago.

Those brought to market are caught in Marin county, in brooks and boggy places beyond San Rafael; in San Mateo county; even as far away as Visalia, which, from its position in what is known as the "Four Creek Country," would seem to be especially fitted for their production.

Two or three Frenchmen are the only people who systematically make it their business to catch these batrachian delicacies; and when we consider the long and toilsome journeys across rough country that these men have to perform, we cease to wonder that they are not cheap.

Chelopus marmoratus Baird and Girard. Out of about thirty-eight species of fresh-water turtles or terrapins found in the United

¹The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

States, one only, known to zoölogists as *Chelopus marmoratus*, is, so far as I am aware, found in California, and is the terrapin of our markets.

Terrapins were once common in the creeks and ponds around the bay, but the constant demand for their flesh has made them scarce, so that the present supply comes from the region around Sacramento, from Knight's Ferry, from Tuolumne county, and the southern part of the San Joaquin valley generally; as well as from the neighborhood of Visalia.

The dealers say that those from Visalia and from the San Joaquin are far superior to those from Sacramento. In the latter the under side is almost white, while in the former it is dark, approaching black; the latter will often die by the dozen soon after they are brought in for sale, while the former will keep alive for months.

A terrapin thus kept and not fed, gradually diminishes in weight, but is not injured in any other way. During its confinement it is really feeding on its own fat, and small as is the range of its activities, and gradual the waste ensuing from them, the results are obvious after a month or two; so that a terrapin kept six or seven months without food, though still alive, is little but shell, bone and skin.

Terrapin are abundant in the reservoir of the San Rafael water works, where, however, fishing is not allowed without permission. There are some in the basin of the fountain at Woodward's Gardens, and of these, having discovered that small lumps of dirt thrown at it while sunning itself on a rock do not hurt it, declines any more to dive under these provocations, and simply cranes its long neck to see what is the matter.

Heloderma suspectum Cope. Several specimens of this large lizard have been presented to the California Academy of Sciences or to Woodward's Gardens during the past year. It attains a length of about eighteen inches, has a thick stout body of a bright yellow color mingled with brown, and it is of a most unattractive aspect, which doubtless accounts for its title of "Gila monster." It has the unenviable reputation of being a poisonous lizard, and although it has been proved not to be poisonous by experiment, as there is not in nature, so far as is known, such a thing as a poisonous lizard, yet the idea is based on a better foundation than that of most popular beliefs, for, as I am informed by Prof. Cope, the front teeth are grooved and there is a gland at the base. For this reason Prof. Cope named it *suspectum*, and he appears to think that after all he would prefer to be bitten by some other kind of lizard.

The Gila monster is slow in its motions, and when pursued will stop and show fight in a feeble sort of way—peculiarities which, together with the large size and conspicuous color, render it easy to be captured, and it is not unlikely that it will ere long

become extinct, as it is killed wherever found. It would be interesting to know what this large, slow-moving lizard finds to live upon in the arid wastes of Arizona.

Chirotos. The curious "hand-eared lizard," which, lizard though it is in structure, would look exactly like a snake were it not for two curious little limbs placed close to the head, has been found in Lower California, a district which, as regards its reptilian fauna, is more properly included in the Nearctic or North American region than in the Neotropical or South American.

No mention is made of this species in the check-list of Nearctic reptiles drawn up by Prof. Cope, and published by the Smithsonian Institution, but two specimens were obtained at La Paz by Mr. Turner, U. S. Consul at that place, and presented to W. I. Fisher, of San Francisco; and Prof. Cope informs me that a European herpetologist has also obtained some from Lower California.

Chirotos belongs to the *Amphisbænia*, which are characterized by a thick short tail, inconspicuous rudimentary eyes, and a body surrounded (as is also the tail) with numerous rings of small square plates. All the genera except *Chirotos* are destitute of limbs, and as they have the power of moving backwards, are popularly regarded as poisonous snakes, possessed of a head at each end of the body. The two little legs, each furnished with five toes ending in pointed claws, save *Chirotos* from this imputation.

The hand-eared lizard is about eight inches long with about two hundred half-rings of small, square plates on the back and a smaller number of half rings of similar but larger scales on the belly. Along the side, where the rings of back and belly meet, are some small triangular scales filling in the interstices.

The mouth is very small, the few plates on the top of the head not conspicuous, the eyes scarcely discernible, and the neck of the same thickness as the body, which is about the calibre of a lead pencil.

Aniella pulchra Gray. This little snake-like creature is entirely destitute of limbs, and is, therefore, usually regarded as a snake, but the structure of the head is lacertian, and it is classed among the *Lacertilia*. It is the only species of its family, the *Typhlopidae*, found in North America, and is probably confined to the southern part of the Pacific region. The *Typhlopidae* are burrowers, with very small eyes and a blunt tail, in these respects resembling the *Amphisbænidae*, but they differ from that family in the character of their covering, which is formed of small diamond-shaped scales instead of regular rings of square or oblong scales.

Aniella pulchra appears to be dug up with tolerable frequency in the southern parts of California, but is not found around San Francisco. It is about eight inches long, slender, of a bright gray color above and light blue underneath, with a band of yel-

low along the center line of the back. A living example, domiciled in a cigar box partly filled with dirt, did not appear to be very active or very timid, as it would rest quietly upon the palm of the hand, and scarcely attempted to move away when touched. When placed upon the dirt in the box, however, it burrowed very deftly.—*W. N. Lockington.*

ANECDOTE OF THE GREAT HORNED OWL.—Many years ago I observed a singular habit of the owl, a notice of which I have never seen published. In the "funny column" of our local newspaper, a paragraph appeared headed "How to kill an Owl," the substance of which was: after finding an owl on a post or tree, you were to have him fix his eyes upon you, and then walk rapidly around him; closing with the statement that he will keep his eyes so intently upon you, turning his head with your movements but forgetting to turn his body, that he will thus wring his own head off.

Nothing is too absurd for a boy to attempt if it promises fun or novelty; and shortly afterward a fine live specimen of a nearly adult *Bubo virginianus* falling into my hands, I proceeded to test the matter by experiment. I placed Bubo on the top of one of my mother's clothes line posts, where he remained motionless and entirely unconscious of the attempt about to be made upon his life. It was not difficult to secure his attention, for he never, while I had him, diverted his gaze from me while I was in his presence. I began walking rapidly around the post, a few feet from it, keeping my eyes fixed upon him all the while. His body remained motionless but his head turned exactly with my movement. Half way round, and his face was directly behind. Three-quarters of the circle, and still the same twist of the neck, and the same stare following me. One entire circle, and no change. On I went, twice round and still that watchful stare and steady turn of the head. I had all this time kept uninterrupted watch of the bird. His talons grasped the top of the post, and his body was perfectly stationary. On I went, three times round, and I began really to wonder why the head did not drop off, when all at once I discovered what I had failed to notice before. When I reached half way round from the front, which was as far as he could turn his head to follow my movement with comfort, he whisked it back through the whole circle so instantaneously, and brought it facing me again with such precision, that I failed to detect the movement, although I was looking intently all the time. I repeated the experiment many times afterward on the same bird, and I had always to watch carefully to detect the movement of the readjustment of his gaze. So rapid and precise was this movement that I failed several times to detect it, even when I was looking expressly for it, and at the proper moment.—*C. A. W.*

NOTE ON THE NOMENCLATURE OF *HESPEROMYS AMERICANUS* COUES AND YARROW.—A note recently published in the *Annals Mag. Nat. Hist.*, by Oldfield Thomas, Esq., "On Robert Kerr's Translation of the 'Systema Naturæ' of Linnæus," gives some important information respecting that rare and obscure book. It appears that, among the Mammalia, the species described in Pennant's *History of Quadrupeds* (1781), and Phillips's *Voyage to Botany Bay* (1789), here receive Latin names, forestalling those in Shaw's *General Zoölogy* (1800-1804).

Among such names are a number affecting North American species. Thus, *Lutra canadensis*, *Mustela americana* and *Didelphys virginiana* must be accredited to Kerr, 1792, not to Shaw or Turton, as we have usually done.

From a private note, kindly addressed to me by Mr. Thomas, it appears, among other things, that *americanus* Kerr, must be used instead of *leucopus* Raf., for the common American white-footed mouse, there being in Kerr, on p. 231, a certain *Mus agrarius americanus*, which is based on Pennant, *Hist. Quad.*, No. 302 b. In their article on Mammals, in Vol. v. of the Wheeler quarto Report of the Survey west of the 100th meridian, Drs. Coues and Yarrow called the species *H. americanus* (Kerr); but afterwards, having meanwhile no opportunity of verifying the reference, Dr. Coues reverted to the use of *H. leucopus* Raf., in *Monog. Rodentia, Muridae*, p. 50 (see also note (2) on p. 51).

Unless, therefore, some still earlier name be forthcoming, this mouse must bear that at the head of this article, and its subspecies, of which there are several, should be called *H. americanus sonoriensis*, *H. americanus eremicus*, *H. americanus gossypinus*, etc.—Elliott Coues, Washington, D. C.

THE FISHES OF KLAMATH LAKE, OREGON.—A collection made at various points on the Upper Klamath lake yielded eight species of fishes, as follows: 1. *Salmo irideus* Gibb. This trout is found abundantly in the lake, as well as in the streams tributary to it; e. g., Sprague river, Wood river, Crooked creek, Fort creek. It reaches a weight of ten pounds, and varies in color from white to red on the sides. 2. *Salmo spectabilis* Gird. The Dolly Varden is less common than the *S. irideus*; the only locality from which I procured it is Seven Mile creek, near Fort Klamath. 3. *Chasmistes luxatus* sp. nov. This is a large fish, and with its congener below named, of no little interest, as extending the range and characters of Jordan's little-known genus *Chasmistes*. Form elongate, head long, flat above, and with a large fontanelle. Mouth terminal, the spines of the premaxillary bones projecting so as to form a hump on the top of the snout. Lower lip a very thin dermal fold, extending entirely around the chin. Scales 12-80-9; radii D. 11, A. 9. Color clouded above with black punctulations; below paler, with red shades in some speci-

mens; fins uncolored. It attains a length of nearly three feet. It ascends the streams in thousands in the spring, and is taken and dried in great numbers by the Klamath and Modoc Indians. The former call it Tswam. 4. *Chasmistes brevirostris* sp. nov. This fish does not exceed 14-16 inches in length, and has a differently formed head and muzzle from the *C. luxatus*. They are shorter, especially the muzzle, and the latter is without the hump produced by the protuberant premaxillary spines. Parietal fontanelle small. The lower lip-fold is only present at the sides of the mandible. Body nearly cylindric. Scales 12-74-11; radii, D. 11, A. 9. Color dusky above, silvery below; fins colorless. This fish is abundant in the lake, but I was informed by a Klamath Chief, that it does not ascend Williamson's river in spring with the *C. luxatus* and *Catostomus*. Klamath name Xoöptu. 4. *Catostomus labiatus* Gird. Very abundant; Yehhne of the Klamaths. 5. ? *Mylopharodon* sp. Not certainly of this genus, and resembling the genus *Anchyropsis*, found fossil in the Idaho and Oregon Pliocenes. I was interested to find this species quite abundant. I am not yet able to ascertain whether the present species is one of those already named or not. 6. *Gila*. A species of medium or small size, and rather robust proportions. 8. *Uranidea*. Undetermined; a stout species, and very abundant.—E. D. Cope.

NEW CLASSIFICATION OF THE CRUSTACEA.—The recent studies on the embryology of the king crab (*Limulus polyphemus*) has shown that there are some unexpected resemblances to the mode of development of the Arachnida, and while in our essay¹ on the development of this Crustacean we attempted to show that the arachnid features were also to be found in certain crabs and shrimps whose development was exceptional, one or two naturalists, as E. Van Beneden and Dohrn, claim that *Limulus* is not a true Crustacean, but belongs next to or with the Arachnida. This seems to us an extreme view. Then followed the beautiful anatomical researches of Alphonse Milne-Edwards on *Limulus polyphemus*, in which he showed the singular relation between the vascular and nervous systems; the latter being enveloped by the ventral system of the arteries. The differences between the nervous system of the king crab and Arachnida has been already indicated.² It has not been, we think, sufficiently taken into account that *Limulus* is a generalized or synthetic type, combining with features of its own, certain resemblances to the Arachnida and to the normal Crustacea. In its mode of respiration, its external gills, and in its circulatory organs it is, as we have previously stated,³ essentially a Crustacean, but should be placed

¹The Development of *Limulus polyphemus*. By A. S. Packard, Jr. (Memoirs of the Boston Soc. of Nat. Hist.) Published March, 1872.

²AMERICAN NATURALIST, Vol. 9, p. 422, 423. July, 1875.

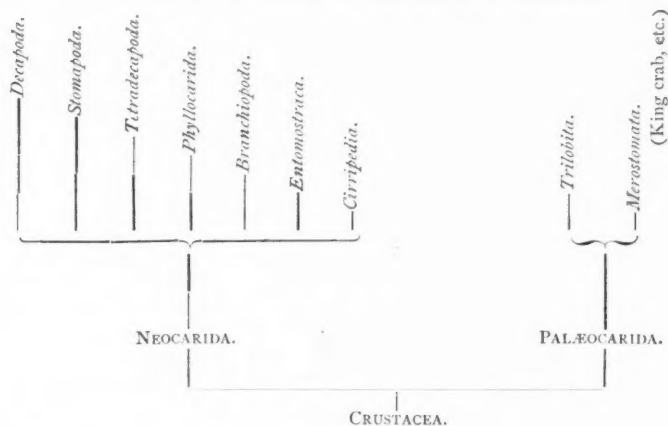
³Farther Observations on the Embryology of *Limulus*, with notes on its affinities AMERICAN NATURALIST, Nov., 1873, Vol. 7, p. 675.

apart from the normal Crustacea, and form the living representative of a subclass, equivalent to all the other living Crustacea. To *Limulus* are closely allied the fossil *Merostomata*; and we regard, for reasons already stated, the *Trilobites* as closely allied to the *Merostomata*.

For this subclass we have proposed the name *Palæocarida*, and for the normal Crustacea we have proposed the term *Neocarida*.

In order to express the relations of the two subclasses of Crustacea, we have published¹ the following table showing the mode of grouping of the different orders of the two subclasses of the class of Crustacea :

CLASSIFICATION OF THE SUBCLASSES AND ORDERS OF CRUSTACEA.



While the *Neocarida* are characterized by the well known features peculiar to all living Crustacea except *Limulus*, the *Palæocarida* have, among others, the following characters: Appendages of the cephalo-thorax in the form of legs, rather than jaws; no antennæ; brain on the same plane as the cephalo-thoracic ganglionic ring, and supplying nerves to the eyes alone; nerves to the cephalo-thoracic appendages sent off from an œsophageal ring; nervous system ensheathed by a ventral system of arteries; metamorphosis slight. Sexes distinct.

Order 1. Merostomata.—No distinct thoracic segments and appendages. (*Limulus*, *Eurypterus*, etc.) *Order 2. Trilobita*.—Numerous free thoracic segments and jointed appendages. (*Agnostus*, *Paradoxides*, *Calymene*, *Trinucleus*, *Asaphus*, etc.; all extinct.)

A farther elaboration of this classification, with full references

¹ Zoölogy for Students and General Readers. American Science Series. By A. S. Packard, Jr. II. Holt & Co., New York. Published in Dec., 1879. Svo, pp. 703.

to the labors of others, is to be given in a second memoir on the anatomy and development of *Limulus polyphemus*, in course of preparation.—A. S. Packard, Jr.

ZOOLOGICAL NEWS.—A number of papers on the Hymenoptera and Coleoptera of the United States, by Messrs. E. Norton, C. A. Blake and Dr. Horn, are in course of publication in the Transactions of the American Entomological Society of Philadelphia.—A detailed and fully illustrated account of the development of *Palaemonetes vulgaris*, by Mr. Walter Faxon, appears in the *Bulletin* of the Museum of Comparative Zoölogy.—Mr. S. H. Scudder, of Harvard University Library, Cambridge, has nearly ready for publication by the Smithsonian Institution an index to all genera hitherto proposed in zoölogy, whether for recent or fossil animals. It is to be based upon the "Nomenclators" of Agassiz and Marschall, and the indexes to the Zoölogical Record.—Prof. Allen Thompson, in *Nature*, confirms the statement that the scorpion commits suicide by stinging itself in the middle of the top of its head.—The early stages of the Cæcilians, or blind snakes, have recently been discussed by Peters, according to *Nature*. An observer in Cayenne saw, according to Herr Wrzensniowski, of Warsaw, a female *Cæcilia compressicauda* give birth, in water, to two young ones alive. The Russian observer, on receipt of the alcoholic specimens, found in the oviduct five more young ones. The young had no trace of lateral gill openings like those discovered in *Epicrion glutinosum* of Ceylon, but it has external bladder-like gills, like those of *Notodolphys oxifera*. Hence these blind amphibia should, when young, be looked for in water. *Cæcilia oxyura* has branchial clefts but no external gills, while *C. rostrata* of the Seychelles has neither branchial clefts or a swimming tail, or any scars showing the former presence of external gills.

ANTHROPOLOGY.¹

ANTHROPOLOGICAL NEWS.—The following vocabulary of the Caddoquis, or Caddo, language was received from Judge J. F. H. Claiborne, of Natchez, Miss., who writes, "It was prepared and sent to my uncle, Gov. Claiborne, of Louisiana, by Dr. Sibley, agent for the Caddos, an educated gentleman. The southern Indians held this tribe in great respect for its supposed antiquity. It was known as the Father tribe."

Among the Smithsonian Comparative Vocabularies, now in charge of Major J. W. Powell, is a short one of the Caddo, No. 444, by Dr. D. J. Macgowan, taken in 1865.

All that remains of this once flourishing tribe are gathered on the Wichita agency, in the Indian Territory. The agent, Mr. A. C. Williams, reports their numbers at 467 persons, principally

¹Edited by Prof. ORIS T. MASON, Columbian College, Washington, D. C.

engaged as farmers and stock-raisers. They are a quiet and inoffensive people, most of whom have adopted the habits of civilized life.

Dr. Sibley's vocabulary was taken in 1804, when the Caddos were located on Red river, from Alexandria to Natchitoches, and follows the French orthography:

Fire, niquor	Face, chanqua'er
Water, cou cou	Eye, chaor
Earth, ouadat cequeteot	Nose, souour
Air, yanour	Cheek, chaminni
Wind, havetour	Chin, soun
Sky, quarchator	Mouth, lip, ouar
Sun, faquor	Tooth, taor
Moon, nis	Tongue, adetour
Star, suoquas	Ear, bistor
Light, binaquor	Neck, nachée
Darkness, dasquoece	Arm, minni
Day, nayañon	Wrist, a
Night, naba	Hand, cenour
Heat, atedot	Finger, cebinour
Cold, acourdout	Belly, binni
Smoke, cousour	Back, chabaches
Cloud, carchavesa	Side, quocher
Fog, cou sour quabariou	Bubby, dantour
Rain, quaveour	Nipple, dante echanqua
Snow, iyna	Thigh, quasour
Hail, tarsour	Leg, casosce
Ice, quitousour	Foot, nasour
Frost, devchea	Toe, senbitour
Dew, cabariou	Skin, nousches
Rain-bow, nachnuvain	Nails, ceonour
Thunder, adenine	Bone, narquour
Lightning, avoidgnauia	Blood, baor
Yesterday, nieschur	Life, quava
To-day, douria,	Death paquaca
To-morrow, cearia	Food, deace nouyour
A day, ouiche deschar	Meat, quaoutour
A month, ouiche nis	Fat, acayou
A year, ouiche adavayour	Lean, nargou
Spring, asnis	Bread, dasquat
Summer, year caades	Indian-corn, quaces
Autumn, nibba	Milk, sou-sou
Winter, chei	Egg, nosbiquor
Man, chouve	House, sahor
Woman, nateg	Mammoth, douriates
Boy siarches	Buffalo, tanaa
Girl, nategches	Elk, oueyat
Child, anin	Deer, da
Father, a-sin	Bear, naeches
Mother, sasin	Wolf, tacha
Brother, nayin	Panther, quiches
Sister, dardin	Wildcat, ouado
Husband, arnouu	Folecat, vueiet
Wife, danayei	Fox, couons
Son, anin quarcounté	Beaver, chestaor
Daughter, natichetez	Raccoon, hot
The body, catocse	Opossum, narcous
Head, quantour	Hare, diot
Hair, bahat	Squirrel, siouar
Beard, sounnieites	Flying-quirrel, detes.

Ground-squirrel, chiouva aquared	Four, evui
Mole, cequouva	Five, de cequan
Bird, banit	Six, danqui
Eagle, ioy	Seven, bi cequan
Hawk, souit	Eight, daaou cequa
Owl, ouous	Nine, ivui cequa
Turkey, nou	Ten, benaar
Swan, sartos	Eleven—twenty, the numerals double
Wild-goose, quinar	Twenty, benar bit
Duck, can.	Thirty, benaar daaou
Turkey-buzzard, souquates.	Forty, benaar evui
Raven, ouvar	Fifty, benaar decequan
Crow, caquail	Sixty, benaar danqui
Black-bird, quacho	Seventy, benaar bicequa
Crane, douno	Eighty, benaar davuecequa
Pigeon, ouâas	Ninety, benaar ivuicequa
Pheasant, ounani	Hundred, ouische aa sour
Partridge, colati	Two hundred, carquaniauosit
Mocking-bird, quathile quatou	Horse, detama
Red-bird, laodoucé	Dog, deches
Snake, quiqua	White, aquayou
Lizzard, taquon	Black, adegua
Butterfly, banous	Green, barnou sar
Fly, quouni	Blue, a sarquour
Fish, bata	Yellow, aquaij quo
Frog, quidau	Red, atenou
Gold, sounar aquayguo	Good, hanhat
Silver, sounar aquayou	Bad, avouna
Copper, dedot noustor	Large, quarquavevour
Stone, signour	Small, ayortetes
Wood, youcour	High, ayou
Gum, guaruoadat	Low, naver,
Mountain, ouadat iniquo	Narrow, sidites
Hill, chuquaet	Old, anistes
Valley, nicquedaic	Young, siarte
Sea, eiquot aicmaie.	New, souroun
Lake, eiquot	Hard, aiequai
Pond, quanmachar	Soft, achounou
River, baat	Sweet, abe save
Creek, nilday quayarda sar	Sour, abasquo
Spring, quayardacha	Bitter, aquocho
Grass, adeitour	Hot, atedos
Tree, quardacha	Cold, acourdas
Pine, devoas	Dry, adaqui
Cedar, betes	Wet aquarquo
Sycamore, quiour	Strong, adasquar
Ash, quiquor	Weak, aicquaie quoiace
Elm, da auve	Pretty, hanhat
Beech, aligonqua danquone	Ugly, aouna
Birch, saibatocha	Sick, auequarion
Oak, ba	Brave, ches soues
Chestnut, nouba	Cowardly, che inij inij
Hickory, nar	Wise, ouin anet
Walnut, sciar	Foolish, quarnous quourdetaui
Locust, danani	I, quarches
Mulberry, baie	You, naquaya
Vine, sasour	He, deer
Tobacco, yaar	She, annas
Joy, quavrinout	They, davre
Sorrow, gouienout	This, deschez
One, gauenie	That, déhé
Two, bit	To eat, naquiar
Three, daaou	To drink, naquarqu

To sleep, youdic
 To laugh, saqua
 To cry, nasaquaqua
 To sing, yourneiyoue
 To whistle, youdanou
 To smell, nasoeunout
 To hear, youquaibe
 To see, nasaibe
 To speak, nasacoupinte
 To walk, nasavear
 To run, nasaninic
 To stand, daarni
 To sit, dataue

To lie down, darsa
 To smoke a pipe, darquavra
 To love, sendamane
 To hate, atedo ciyer
 To strike, younbín
 To kill, youques
 To dance, youvechan
 To jump, avesaria
 To fall, navvania
 To break, yoniouva
 To bend, darquven
 Yes, aaie
 No, aounna

Mr. James E. Rhoads, of Germantown, Philadelphia, also sends us a translation of the Lord's Prayer in Comanche, made two years since by Frank Maltby, an employé at Kiowa and Comanche agency, near Fort Sill, I. T.:

THE LORD'S PRAYER.

MATT. VI. 9-13.

Our Father, which art in heaven,

Täh Affä, përküne tomowät,

Hallowed be Thy name,

Mohoits süicüt Uh nānia,

Thy kingdom come,

Pun'tht përnë'mänärk täm'ücrëckin,

Thy will be done on earth, as it is in heaven,

Täh so'konäk Uh pee pün'eüne mahän'en, Uh përküne hiäowite,

Give us this day our daily bread,

Isitse täbä nēmëmähk nēmëtehkäro,

Forgive us our debts, as we forgive our debtors,

Tähn hōcōniht nēmësutine, Un hiätänä'sütewite tähsuti'ne,

Lead us not into temptation, but deliver us from evil,

Tähkesiäfpit kä tätschöckäwite, käsiä tähn wäro,

For Thine is the kingdom, and the power, and the glory, forever. Amen.

Un simayërokäwëet pünicks hin nämähcöcüt, ter hin hanit, ërie naniavü, känäc-kämëwite. Soonëñähän.

The Fifteenth Bulletin of the United States National Museum contains the report of several naturalists upon the scientific results of the Howgate Expedition. Mr. Ludwig Kumlien, naturalist of the expedition, contributes a paper consisting of fragmentary notes on the Eskimo of Cumberland sound. There will be found enough of mythology and linguistics in the contribution to repay perusal.

Two works on the ancient races of America are advertised under the following titles: "Footprints of Vanished Races in the Mississippi Valley; being an account of some of the Monuments and Relics of Prehistoric Races scattered over its surface, with suggestions as to their origin and uses. By A. J. Conant, A.M. C. R. Barns, St. Louis, Mo. \$1.50." "The North Americans of Antiquity; their Origin, Migrations and Type of Civilization considered. By John T. Short. Pages 530. Harper & Brothers, New York."

GEOLOGY AND PALÆONTOLOGY.

THE CAVE BEAR OF CALIFORNIA.—In exploring a cavern in the Carboniferous limestone of Shasta county, Cal., James D. Richardson discovered the skull of a bear beneath several inches of cave earth and stalagmite. The specimen is in a good state of preservation, and demonstrates that the cave bear of that region was a species distinct alike from the cave bear of the East (*Ursus pristinus*), and from any of the existing species. In dimensions the skull equals that of the grizzly bear, but it is very differently proportioned. The muzzle is much shorter, and is wide, and descends obliquely downwards from the very convex frontal region. It wants the large postorbital processes of the grizzly, but has the tuberosities of the polar bear (*U. maritimus*), which it also resembles in the convexity of the front. Sagittal crest well developed. Three (one median and posterior) incisive foramina: three external infraorbital foramina. The teeth are large, and the series presents the peculiarity of being without diastema. The crowns of the premolars are not preserved, but if there were not three premolars, the second tooth has two well developed roots. First true molar with but two external and one internal tubercle. The absence of diastema renders it necessary to separate this bear from the true *Ursi*, and I propose to regard it, provisionally, as a species of *Arctotherium* Gerv. The canine teeth are large and compressed at the base. Length of cranium along base from below apex of union to premaxillary border, m. 0.387; length to posterior nares, .202; elevation of forehead vertically above the posterior extremity of the last molar, .141; width between inner border of posterior molars, .076. The species may be called *Arctotherium sinum*.—E. D. Cope.

GEOGRAPHY AND TRAVELS.¹

THE SWEDISH ARCTIC EXPEDITION.—An account of the voyage of the *Vega* up to August 27, 1878, at the mouth of the Lena river was given in our number for February last. After separating from the *Lena* they steered north-east toward the most southern of the New Siberian islands. These islands are remarkable for the numerous remains of the mammoth and a great quantity of coeval animal forms, which are found on them more abundantly than in the Tundra of the continent. A really thorough scientific examination of these islands has yet to be made.

Continuing on their course in the ice-free channel along the coast they reached the Baranov islands on the 3d of September. From here they passed through dense masses of floating ice until the 28th, when they were finally beset near the East cape, at Koljutschin bay 67° 6' N. and 173° 15' W., where they passed the winter. From letters from Prof. Nordenskiöld and from the

¹ Edited by ELLIS H. YARNALL, Philadelphia.

correspondence of the New York *Herald*, we learn that the winter was a severe one; intense cold with constant north-west winds, with only rare intervals of mild weather, was experienced. Snow-storms were of almost continual occurrence. Three camps of Tschuktschi were on the shore near their anchorage. These savages possess many excellent traits. They are amiable, obliging and peaceable, both among themselves and towards strangers. Their complexion is a brownish-yellow, hair and eyes generally black. The features are less Mongolian in type than are those of the Esquimaux, or the other indigenous tribes of Siberia. The men are tall and the young women often of perfect symmetry and fine proportions. They trade frequently with the American shore, which is accessible in winter and summer over ice or the open sea. They live in tents, dress in skins and subsist on seals, reindeer, bears, fish and vegetables. The women are tattooed on the face. The language spoken by this tribe is peculiar, and so far shows no affinity to others. A lexicon of 300 words has been made by Lieut. Nordqvist.

During the whole period that the *Vega* remained at Koljutschin bay, hourly meteorological and magnetic observations were taken. The months of March, April and May were very cold. In June the temperature became more supportable. From the very slight rise and fall of the tide, Prof. Nordenskiöld believes the sea north of Behring strait must be small, and is probably circumscribed by islands between Wrangel land and the archipelago of which Prince Patrick's island is the most western now known. No sickness occurred on board, owing, doubtless, to an abundance of good provisions, including a little fresh meat even in the severest months, good discipline and the superior physique of the members of the expedition. The advancing spring brought large flocks of birds; many of these are supposed to winter in Japan and others in North America. Dr. Stuxberg has sent to the Academy of Science in Stockholm, a preparatory memoir regarding the numerous specimens collected by the dredge, during the voyage, of Crustacea, Echinodermata and Crinoida. Some are of extraordinary size and not previously known. This portion of the Arctic sea, though comparatively poor in Algæ, afforded many specimens corresponding in the western portion to the European and in the eastern to the Pacific varieties. Large collections of mosses and lichens were also made. The northern lights never attained the brilliancy observable in Scandinavia.

Nordenskiöld calls attention to the difference in the coast east to that west of the Lena: "On the western side the country rises northward almost to the 78° , or to a latitude exceeded in very few places on the Polar sea, and where we may generally fear to encounter impenetrable masses of ice. On the eastern side the coast slopes gradually southward, and the sound which

unites the waters of the Arctic sea with those of the Pacific ocean is situated south of the Polar circle, or in about the same latitude as Haparanda.¹ On the western side the coast stretches out in a wide, treeless Tundra, while on the other side the forest boundary between the Lena and Behring strait extends in many places nearly to the coast. On the western side the coast lines are very incorrectly represented on the charts, so that we have sailed over a surface of nearly five hundred kilometres laid out as land on the latest maps of Siberia. But we have not been able to discover any considerable errors in the charts of the eastern coast."

On July 18th they were at last set free and entered Behring strait, and after stopping at Saint Lawrence bay, Port Clarence and Saint Lawrence island, they visited Behring island, where remains of the gigantic animal, *Rhytina stelleri*, exist, and bones sufficient to constitute several almost perfect skeletons were obtained. On the 2d of September, 1879, the *Vega* arrived safely at Yokohama, Japan.

While the north-east passage has thus been made successfully, it is doubtful whether the commercial results will be very important. The time during which the channel thus shown to exist, remains open, it is to be feared is too brief, and the risks of navigation too great, to afford much encouragement to the merchants of San Francisco to open trade with Siberia, as suggested by M. Siberiakoff in a letter to the New York *Herald*.

The commerce that was springing up on the western side from Europe, through the Sea of Kara to the Obi and Yenisei, has received a serious check this summer, as none of the six steamers attempting the voyage have been able to penetrate the ice which has obstructed the approaches to the Kara sea.

Not the least remarkable incident in the voyage of the *Vega* was the audience given the explorers by the Mikado of Japan and the honors paid them by the Tokio Geographical Society, the Asiatic Society of Japan and the General Asiatic Society at a banquet, at which the President of the Geographical Society, a prince of the imperial blood, presided.

Petermann's *Mittheilungen* for May, 1879, contains a valuable article, by M. Lindeman, on the north coast of Siberia, from the mouth of the Lena to Behring strait and is accompanied by an excellent and very detailed map in two sheets. An account of the authorities relied on, and the sources of information regarding this region used in preparing this map is given by the author, B. Hasentine, in the number for June.

PROCEEDINGS OF THE GEOGRAPHICAL SECTION OF THE BRITISH ASSOCIATION.—The British Association for the Advancement of Science held its forty-ninth meeting at Sheffield, from the 20th to

¹ At the head of the Gulf of Bothnia.—*Editor*.

the 27th of August. While the general attendance was much smaller than usual, the Geographical Section, under the presidency of Mr. Clements R. Markham, and favored with the presence of several distinguished travelers from abroad, had large assemblages at all its sessions. Mr. Markham, in his opening address, treated of the objects and aims of geographers and the position which the science holds, relatively, with reference to other sciences, and positively as a distinct body of knowledge with definite limits.

"We are still very far indeed," he said, "from an accurate scientific geographical knowledge of even the most civilized countries, while by far the largest portion of the earth's surface is inadequately surveyed, and a smaller, though far from inconsiderable, part is unsurveyed or entirely unknown. In the division of labor, the geodetist produces the accurate large-scale maps which are necessary in thickly populated countries, the topographical surveyor furnishes less exact maps of more thinly peopled and less civilized regions, while the trained explorer forces his way into the unknown parts of the earth.

Accurate maps are the basis of all inquiry conducted on scientific principles. Without them a geological survey is impossible; nor can botany, zoölogy or ethnology be viewed in their broader aspects unless considerations of locality, altitude and latitude are kept in view.

The surveying and mapping of the ocean is only second in importance to that of the land; and this work also divides itself into three sections, namely: the coast surveyed, the coasts partially surveyed and the unsurveyed coasts. Hydrography will not be completed until all the coasts in the world are included in the first section, which is now very far indeed from being the case. He had spoken of the measurement of the surface of land and sea, and of their heights and depths; to the mapping of the world and to the innumerable uses of maps and charts. But this only forms the skeleton of our science, which is endued with flesh and blood, with life and motion by those who study the causes and nature of the changes that have taken place and are now taking place upon the earth; by comparative and physical geographers, by those who study and classify natural phenomena, and demonstrate their connection with each other and their places in the great scheme of nature. The importance of the study of history and of early narratives for the elucidation of points in physical geography will appear from the consideration of a few instances. Take, for example, the great and fertile basin of the River Ganges, in India. The Sanscrit historian finds reason for the belief that in 3000 B. C. the only habitable part of the alluvial plain of India was the water-parting or ridge between the Sutlej and the Jumna. The rest was a great estuary or arm of the sea. It has only been fit for man's occupation within the historical period, and hundreds

of square miles of the delta have become habitable since the days of Lord Clive. The wonderful history of these changes can be traced by the student, who thus enables the geographer to explain the phenomena which he observes. Again, to pass to another part of the world. The student of history reads of the great sea fight which King Edward III fought with the French off Sluys; how in those days the merchant vessels came up to the walls of that flourishing seaport by every tide; and how, a century later, a Portuguese fleet conveyed Isabella from Lisbon, and an English fleet brought Margaret of York from the Thames to marry successive Dukes of Burgundy at the port of Sluys. In our own time if a modern traveler drives twelve miles out of Bruges across the Dutch frontier he will find a small agricultural town surrounded by cornfields, and meadows, and clumps of trees, whence the sea is not in sight from the top of the town-hall steeple. This is Sluys. A physical geographer will seek out the causes which have brought about this surprising change. They are most interesting, and most conducive to an intelligent comprehension of his science, and he will find them recorded in history. Thus the historian and the geographer work hand in hand, each aiding and furthering the researches of the other."

The second day's session was devoted to African exploration and papers by Maj. Serpa Pinto and Lieut. Savorgnan de Brazza on their recent journeys, were read. Of Maj. Pinto's journey, Com. Cameron remarked that it was one of the greatest ever made, his positions were accurately laid down and his observations were carried out in such a way as had never been done on any previous expedition, and when his book was published they would have a mass of scientific knowledge such as had rarely, if ever, been acquired in the same space of time and with the same limited amount of means at command.

Several important papers on Afghanistan were read, which had been prepared by officers and others with the English army during the war. Many explorations have been made in the unknown portions of this country, and the most important result is the destruction of the belief heretofore held that there were only three entrances into India on the north-west, and that if these passes were blocked up India was safe. It now appears, as stated by the president, that the whole country, from Jellalabad to the Bolan pass, could be crossed in any direction, and that the several roads were perfectly free and open grass plains except where they debouch on the Indian plains. The "scientific boundary," therefore, has no existence, and there must be a continuous frontier from north to south with lateral communications along it.

A paper on Arctic research, by Com. L. A. Beaumont, R.N., of the recent British Arctic expedition, advocated the prosecution of

the work by way of Smith's sound to the land around Cape Britannia. This involves the discovery of the northern side of Greenland. He prefers this route to an attempt along the eastern side because a higher latitude can be reached by Smith's sound, and he believed that a vessel might winter on the eastern shore of Robeson strait and advance depots to Repulse harbor in the autumn. Com. Beaumont, who has seen Cape Britannia, the most northern known point of Greenland, believes that to stand on its highest peak would alone throw much light on Greenland geography.

A paper, by H. Rink, on "The Interior of Greenland" was read. This paper pointed out the principal feature, ice, in the interior of Greenland, and gave an account of the proceedings of recent expeditions for its exploration. The center of the country was stated to be a mass of movable ice. On this paper Com. Beaumont described a small tribe of people in the north of Greenland, cut off from all other peoples by glaciers. They hunted the seal, and would sit over a hole for three days in cold that would kill any other person. They were well disposed to Arctic explorers, but were dying out, two hundred only remaining of a once large tribe. The wonder of this people at seeing a ship was beyond all description.

A paper, by Lieut. Com. Wyse, on "The Exploration of the American Isthmus and the Inter-oceanic Canal" gave an account of the route selected by the recent International Congress at Paris. Adverse opinions to the scheme were expressed by Com. Cameron and other members.

MICROSCOPY.¹

MICROSCOPICAL LABORATORY.—Dr. Carl Seiler, of Philadelphia, has opened a laboratory for the instruction of students in histology, pathology, and microscopical technology. A fee of \$15 is charged for a course of twelve lessons. Microscopical examinations of pathological and other specimens will be made to order, and a large variety of histological and pathological specimens will be prepared for sale.

TRICHINA SPIRALIS.—Dr. Jas. A. Close, of Summerfield, St. Clair Co., Ill., is mounting specimens of this parasite in its different stages of development, by a modification of Beale's method, with considerable success. These difficult objects can be obtained from him by mail.

REMOVAL.—Wm. Wales has removed from Fort Lee, N. J., to No. 361 West 34th St., New York City. At this address he intends to keep a full supply of goods by Zentmayer, Beck and other makers, for the accommodation of those who may wish to

¹ This department is edited by Dr. R. H. WARD, Troy, N. Y.

examine and select at leisure, and with the quiet and comfort of a private residence. He will continue to supply his own lenses, unless other makes are preferred.

ERNST GUNDLACH.—This well-known optician announces another business change, by which he will devote his time exclusively to manufacturing, and L. R. Sexton, of Rochester N. Y., will attend exclusively to the department of business correspondence, selling goods, etc. He claims to have recently made great improvements in objectives and oculars, and to have invented an entirely new form of binocular arrangement, description of which is not yet published. He announces five styles or classes of objectives, as follows: Class A, triplets, consisting of a crown glass lens cemented between two flint glasses of different kinds, mounted in the back part of a tube, which has a diaphragm in front to cut off stray light; these triplets ranging from a 4 inch of 8 degrees to $1\frac{1}{2}$ inch of 18 degrees. Class B, dialytic objectives, consisting of two separated achromatic combinations, arranged with special reference to flatness of field. These are of two grades; the first composed of two doublets, and ranging from a 4 inch of 10 degrees to a $\frac{1}{2}$ inch of 40 degrees; and the second composed of two triplets, and ranging from a 2 inch of 24 degrees, requiring a microscope body with internal screw one inch wide, to a $\frac{1}{2}$ inch of 36 degrees; these triplets can be separated, giving half of the same powers. Class C, aplanatic objectives, three system lenses, the front being a triplet, having large flat field, and chemical and visual foci nearly together, specially suited for photography, and ranging from a 1 inch of 26 degrees to a $\frac{1}{4}$ inch of 80 degrees. Class D, resolving objectives, three systems, and either dry, or glycerine immersion; the former varying from a $\frac{1}{2}$ inch of 100 degrees, requiring an internal screw of one inch to a $\frac{1}{8}$ inch of 130 degrees, and the latter from a $\frac{1}{4}$ inch of 115 degrees water angle, to a 1-16 inch of 120 degrees water angle. Class E, cedar oil immersions, four systems, with long working focus and high resolving qualities, varying from a $\frac{1}{4}$ inch of 140 degrees water angle, requiring an internal screw of 1 inch, to a 1-25 inch of 150 degrees water angle. Mr. Gundlach introduced at the meeting of the Rochester Microscopical Society, on the 13th of October, last, a "globe lens," consisting of a hollow sphere of flint glass, made in halves, and containing a solid sphere of Crown glass of certain proportionate density. A corrected lens is thus obtained, having long working focus in addition to the well-known advantages of the Coddington form. As yet they have only been made as pocket magnifiers.

SCIENTIFIC NEWS.

— The council of the Entomological Society of London are authorized by Lord Walsingham and other gentlemen interested in the diseases of British game-birds, to offer to public competition the following prizes: £50 for the best and most complete life-history of *Sclerostoma syngamus* Dies., supposed to produce the so called "gapes" in poultry, game, and other birds; £50 for the best and most complete life-history of *Strongylus pergracilis* Cob., supposed to cause the grouse disease. No life-history will be considered satisfactory unless the different stages of development are observed and recorded. The competition is open to naturalists of all nationalities. The same observer may compete for both prizes. Essays in English, French, or German to be sent in on or before October 15, 1882, addressed to the secretary of the society, 11 Chandos street, Cavendish Square.

— At the Sheffield meeting of the British Association, Dr. Crichton Browne delivered an address on influence of domestication on brain growth. He had found by experiments that domestication had greatly reduced the brains of the duck, and he argued that men, like ducks, might be fed and housed, fenced about, and exempted from participation in the life struggle until, like the ducks, they would depreciate in mental capacity. Their bodies might increase in size and succulence, but their brains would become straitened and withered. Disease and luxury crippled the brains. It was as true as ever that men were perfected through suffering, toil and conflict, and it was not through affluence and comfort that genuine civilization was attained. It was the civilization, not merely the domestication of mankind, that must be aimed at.

— Next to the name of Dr. T. W. Harris that of Dr. Asa Fitch will be held in especial remembrance for his valuable and numerous contributions to economical entomology. For many years before his death, which occurred April 8th last, at the age of seventy, he ceased to correspond with American entomologists, and to those of the present generation he was almost entirely unknown. A biographical sketch with a likeness, by E. P. Thurston, appears in the *Popular Science Monthly* for November.

— W. W. Saunders, who died Sept. 13th, was one of the leading English promoters of botany and entomology, being unequalled as a patron of natural science. He will be remembered by his *Insecta Saundersiana* and *Refugium Botanicum*, and a number of papers on entomology, botany and horticulture.

— We have neglected to record the death, in April last, of Dr. Hermann Loew, who has been so voluminous and painstaking a writer on Dipterous insects, and has described and monographed so many American flies, chiefly in the publications of the Smithsonian Institution. His collections are in the Cambridge Museum.

-- Prof. Cope has recently returned from an extended trip to the Pacific coast. Going and returning he made excursions into Colorado to the fields explored by him in 1873, and to the Jurassic beds of the Rocky mountains which have yielded the remains of the most gigantic of land vertebrata, the *Opisthocæla*. Desirous of ascertaining whether, after an interval of six years, a once productive locality would yield a new crop of fossils to the process of atmospheric erosion, he made an exploration of a part of the plains in the eastern section of the State. The region has been twice overrun and depopulated by the Cheyenne Indians since his expedition of 1873, hence a short stay was thought to be sufficient to accomplish the objects in view. On going over the ground, the topography showed moderate results of erosion. This had been sufficient to expose a great many fossils, several of them nearly complete skeletons. Such were found of species of *Hypertragulus*, *Poebrotherium*, *Oreodon*, *Hoplophonus*; there were also numerous jaws of *Temnocyon*, *Amphicyon*, *Dinictis*, *Mesodectes*, and many Rodentia. After a further successful search in the Loup Fork horizon, which yielded, among other things, *Pseudelurus intrepidus*, the outfit returned. The weather was cold; bread had to be cut with a hatchet, and water thawed out by the fire.

At the Jurassic beds, measures were taken for the further exhumation of *Camarasaurus*. Some fine specimens of a carnivorous Dinosaur of the genus *Hypsirophus* were obtained, and the greater part of the skeleton of *Amphicælias altus* was secured.

Prof. Cope visited the Lower Miocene beds of the John Day region of Oregon, the scene of many recent explorations. His party had had excellent success, and had nearly exhausted the locality. Among other interesting specimens, they had obtained crania of five species of *Felidæ*, one of them a true *Machærodus*, *M. strigidens* Cope, of small size; and others of older type and larger size, which are described below. The skull of the *Hoplophonus platycopis* was observed by the members of the party (under J. L. Wortman) perched on a pinnacle of an almost inaccessible precipice, and several fruitless attempts to reach it were made. At length Leander Davis, an experienced collector, secured the prize, which is, so far as known, unique in Prof. Cope's collection.

The most remarkable species of fossil cat is the *Archælorus debilis* Cope, gen. et sp. nov. Generic characters: Dentition, I. $\frac{3}{3}$, C. $\frac{1}{1}$, Pre-m. $\frac{1}{1}$, M. $\frac{1}{2}$; mandible with the anterior face of the symphysis separated from the lateral face by an angle which is not produced downwards. Superior sectorial without anterior lobe; inferior sectorial with heel. The characters place *Archælorus* at the base of the *Felidæ*, showing that it is the most generalized form yet known, and about equally related to the feline and Machærodont series. Char. specif.: General structure of the jaws, weak; superior canine, small, little compressed, with

an acute posterior edge which is not serrulate; first premolar in each jaw, one rooted; second inferior premolar, large; sectorials large; diastemata very short; alveolar border below the inferior sectorial and tubercular teeth everted, forming a large osseous callus which has a free inferior and posterior margin, the latter rising into the base of the coronoid processes; zygomatic slender; postorbital processes little prominent; front, wide, convex transversely. Length of cranium, m. .200; superciliary width, .052; zygomatic width, .124; length from orbit to superior incisors, .066; length of superior sectorial, .023; do of inferior molar series, .064; diameter of superior canine, .012. About the size of the panther, or of the *Nimravus brachyops*.

Hoplophoneus platycopis Cope, sp. nov. This is the largest sabre-tooth discovered in North America. It is twice the bulk of the *H. primævus* Leidy, and differs from that species and the *H. occidentalis* in the relatively large size of the premolar teeth, which are less obliquely placed than in the latter. The first superior premolar is very small; the canine is large and compressed as in the species of *Machærodus*, and has serrulate posterior and anterior cutting edges. Inferior incisors with conic crowns. The symphysis is very deep in consequence of the large development of the inferior flares for the canines. Sagittal crest making a very steep angle with the front. Total length of cranium, m. .280; zygomatic width, .192; length from orbit to superior incisors, .095; length of superior sectorial, .025; of inferior do, .022; do of inferior molar series, .055; length of crown of superior canine, .060; width of do. at base, .026. This skull is one-sixth smaller than that of the Bengal tiger (*Uncia tigris*).

— The Permanent Exhibition of Philadelphia has received a temporary set-back in consequence of the issuing of an order for the removal of its building by the Park Commissioners. This extraordinary proceeding was the work of a majority of a mere quorum of that body, who met during the summer months while the remaining members of the commission were away from the city. The action of these men reminds us of that of Judge Hilton, of the New York Central Park, who destroyed Waterhouse Hawkins' restorations of extinct animals, and razed the building that was to contain them. The press of Philadelphia have unanimously condemned the commission, and demanded the continuance of the exposition.

— Thos. G. Gentry is engaged on a work on the fertilization of plants by insects, based on observations made in Pennsylvania and New Jersey.

— Prof. D. S. Jordan is preparing a work on the fishes of North America.

— Prof. O. B. Johnson, of Salem, Oregon, can furnish well prepared specimens of the fauna of Oregon at reasonable rates.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE NATIONAL ACADEMY OF SCIENCES.—The academy held its semi-annual meeting in New York, Oct. 28–30, 1879, in the new building of Columbia College, under the presidency of Prof. William B. Rogers. In opening the meeting, Prof. Rogers made the following references to the recent discoveries in science:

"In all branches of discovery we seem to be catching the clews of far-reaching thought, that stretch out where, as yet, no man's foot has trodden. As among some of the most recent of these may be instanced the evidence, amounting almost to proved assurance, by which Prof. Whitney places the existence of man at least as far back as the Pliocene era. We have the researches of Prof. Lockyer, almost demonstrating that substances hitherto regarded as elements can be regarded as compounds, and indicating that all matter may be ultimately resolvable into simple forms. There are the marvelous displays of what has been called the 'radiant force' of matter, as shown in the experiments of Prof. Crookes with new varieties of the radiometer. New ranges of profound inquiry are opening before us in the directions indicated by electrical inventions, such as the microphone and the telephone."

The following papers were read on subjects connected with biology and geology and anthropology: Original researches reported in the second medical volume of the medical and surgical history of the war of the rebellion, by J. J. Woodward; Some observations on the structure of the human brain, by J. C. Dalton; Some remarks on a new map of the Catskill mountains, and on the topographical relations of that mountain group to the adjacent regions of the Appalachian system, by A. Guyot; On the glycogenic function of the liver, and On old river-beds of California, by Joseph Le Conte; On some new and remarkable forms of Crinoidea from the lower Helderburg formation, and Notes on the *Lycoperdites vanuxemi* and allied forms, by James Hall; On the vegetation of the Atlantic coast of North America in the Cretaceous age, and On some interesting deposits of gold and silver ores in Utah and Colorado, by J. S. Newberry.

Prof. Guyot, in the course of his remarks on the Catskill mountains, distributed copies of his new map among the members especially interested. His object was to call attention to the geological problems exhibited by the Catskill plateau. He did not regard the carving of the mountains as glacial work, though the evidence of glacial scratches was not wanting. The process which had taken place, he thought, was an elevation of the whole district. But at the time of that rise the Adirondack formation was already in position, and by it the Catskill plateau was squeezed as it rose. The mountains which now occupy the place of that plateau were left by erosion, their valleys being carved

out by rivers. Prof. James Hall, in the discussion that followed, expressed himself as delighted with the adhesion of so good an observer as Prof. Guyot to this theory of the formation of mountains by erosion, and not by their separate upheaval. Prof. Rogers described an instance where one of the Shenandoah mountains could scarcely have been formed by a separate upheaval, for all its strata were horizontal from bottom to top; but the surrounding region was full of the evidences of disturbance.

APPALACHIAN MOUNTAIN CLUB, October 8.—Mr. W. Wells read a paper on the new paths at Waterville, N. H.; Prof. C. E. Fay gave an account of the connection of the Portland White Mountain Club with Mt. Carrigan; President Niles spoke of the mountain studies of the late Violet-le-Duc; Prof. A. Geikie, of Edinburgh, was present, and addressed the meeting.

BOSTON SOCIETY OF NATURAL HISTORY, October 15.—Prof. E. S. Morse read some archæological notes on Japan, and Mr. W. O. Crosby remarked on distorted pebbles in Conglomerate from the Brighton district of Boston.

PROCEEDINGS OF MIDDLESEX SCIENTIFIC FIELD CLUB, MALDEN, MASS., November 5.—Frank S. Collins read notes on the marine Algæ of Middlesex county, Mass, in which twenty-nine species and one variety were enumerated. Among those new or rare in this locality were *Ralfsia clavata* Cronan, *Enteromorpha clathrata* Grev., var. *prostrata*, *Cladophora expansa* Kutz., *Rhizoclonium riparium* Harvey, and *Spirulina tenuissima* Kutz. The county has no coast line, and all collections were made in a small stream flowing into Mystic river. H. L. Moody read notes on the Asters, enumerating twenty species and two varieties collected in the county.—*Geo. E. Davenport, Sec'y.*

CALIFORNIA ACADEMY OF SCIENCES, November 3.—The regular fortnightly meeting was held Nov. 3d. B. B. Redding occupied the chair. F. Slate, Mrs. T. H. Hittell, Oscar T. Barron, Hon. John H. Sanders. Frederick Ludemann, C. A. Webb and C. E. Locke were elected members of the association. In the absence of Prof. Davidson, who was to have addressed the association, Prof. Cope, who was present was invited to speak. The invitation was accepted, and the gentleman spoke at some length on several points in the palæontology and zoölogy of California. He first exhibited the skull of a large bear, found by J. A. Richardson in a cave in Shasta county, on the McCloud river. This specimen was said to belong to a species hitherto unknown, which resembles the bear of the pampas of Buenos Ayres. The California cave bear is so far distinct from the existing bears as to make it necessary to refer it to a distinct genus, which is probably the same as that to which the pampean bear belongs. Prof. Cope named it *Arctotherium simus*. It was as large as the grizzly

bear, and is peculiar in its short muzzle and bull-dog face. The speaker next exhibited a specimen of a lizard from the museum at the university at Berkeley, which was collected by Dr. J. G. Cooper, of the Geological Survey of this State. He stated that it was a new species of a little-known genus (named *Xantusia* by Baird), and formed an interesting addition to the herpetology of California. He named it *Xantusia riversiana*, in compliment to Mr. Rivers, of the University of California. Prof. Cope next called attention to a pair of feet of a deer belonging to the Academy, which were sent from Mendocino county. Each of these possessed but one central toe and hoof, instead of the usual pair. The speaker stated that the toes of the hinder feet were united throughout, and were so far developed beyond the usual point attained by the ordinary ruminant. The toes of the fore limb were different, one only being continued to the hoof, all the others being rudimental. "On the Hog-wallow Land of the San Joaquin valley," a very interesting paper, was read by Judge Hastings, and gave rise to considerable discussion. The title refers to the mound-lands common on the Pacific coast, such as occur at San Diego, on the Sacramento, Columbia, etc.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

BULLETIN OF THE U. S. GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, VOL. V, No. 2.—September 6. On the Coatis, by J. A. Allen. On the present status of *Passer domesticus* in America, with especial reference to the Western States and Territories, by Dr. Elliott Coues. The Laramie group of Western Wyoming and adjacent regions, by A. C. Peale. On Lithophane and new Noctuidæ, by A. R. Grote. Palæontological Papers, No. 11.—Remarks upon certain Carboniferous fossils from Colorado, Arizona, Idaho, Utah, and Wyoming, and certain Cretaceous corals from Colorado, together with descriptions of new forms, by C. A. White; The so-called Two-ocean pass, by F. V. Hayden; On the extinct species of Rhinocerotidæ of North America and their allies, by E. D. Cope. Second installment of American Ornithological Bibliography, by Elliott Coues.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.—October. On some points in the development of the common newt, by W. B. Scott and H. F. Osborn. The structure of *Haliphysma tumanowiczii*, by E. R. Lankester (is not a sponge but a Protozoön). *Lithamaba discus*, one of the Gymnomyxa, by E. R. Lankester. On the structure of the vertebrate Spermatozoön, by H. Gibbs.

THE GEOLOGICAL MAGAZINE.—October. On the classification of the British Pre-cambrian rocks, by H. Hicks. Origin of pipe ore, by J. P. Lesley.

THE FOURTEENTH YEAR

— OF —

THE AMERICAN NATURALIST:

A POPULAR ILLUSTRATED MONTHLY MAGAZINE OF NATURAL
HISTORY AND TRAVEL.

ANNOUNCEMENT FOR 1880. (VOLUME XIV.)

THIS journal of popular Natural Science is published by Messrs. McCALLA & STAVELY, Philadelphia, Pa., under the editorial management of Dr. A. S. PACKARD, Jr., and Prof. E. D. COPE, with the assistance of eminent men of science. The typographical dress and illustrations which have heretofore given character to this magazine will be sustained, and it will be of a thoroughly popular nature, so as to interest the general reader as well as the young naturalist. It will continue to be a journal of science-education and for the use of science-teachers.

Each number of the *NATURALIST* contains carefully written articles on various scientific subjects, and, in addition, departments of *Recent Literature*, *Botany*, *Zoology*, *Anthropology*, *Geology* and *Paleontology*, *Geography* and *Exploration*, and *Microscopy*. The department of Birds and Mammals is edited by Dr. ELLIOTT COUES, U. S. A., and that of Microscopy, by Dr. R. H. WARD, of Troy, N. Y. The Department of Geography and Travels is edited by ELLIS H. YARNALL, Esq. Prof. O. T. MASON will continue his monthly summaries of Anthropological News, and will edit the Department of *Anthropology*. Arrangements have been made to report the *Proceedings of Scientific Societies* with great promptness. A Digest of the *Contents of Foreign Scientific Journals and Transactions* will also be given each month, together with the *Latest Home and Foreign Scientific News*.

The attention of publishers and teachers is called to critical notices of scientific books, to which especial attention will be given.

A new feature and one which will render *THE NATURALIST* most useful to American scientists and students of science, are summaries of progress made during the preceding year (1879) in different departments of science. Reviews of progress in *Geology* will be furnished by Prof. T. STERRY HUNT; in *Botany* by SERENO WATSON, Esq.; in the study of *Mammals* and *Birds* by Dr. ELLIOTT COUES, U. S. A.; of *Fishes* by Prof. THEODORE GILL; of *Crustacea* by Mr. J. S. KINGSLEY; of *Mollusca* by Dr. W. H. DALL, and of other classes by the Editors; Prof. C. A. WHITE will report on *Invertebrate Paleontology*; Prof. OTIS T. MASON will prepare a report on progress in *American Anthropology* during 1879. *American Geography and Explorations* will be reported upon by ELLIS H. YARNALL, Esq., and *American Microscopy* by Dr. R. H. WARD.

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INDEX.

- Aboriginal Customs, 6.
 Aceratheria, 333.
 African explorations, 51, 334, 404, 533, 592, 660.
 Albulu vultures, 308.
 Aldrich, C., on mimicry in a snake, 711.
 on red-headed woodpecker, 522.
 on vibrations in the tail of snakes, 712.
 on wrens and the bee moth, 262.
 Alepidosaurus ferox, 455.
 Alfilarilla, 413.
 Algae of Great Salt lake, 701.
 Allinson, J., on the swallow, 706.
 Ambloplites interruptus, 299.
 Amblychila cylindriciformis, 595.
 Amblystomum mavortium, 438.
 Amia calva, 525.
 Amnicola longinqua, 147.
 Ampelopsis quinquefolia, 680.
 Amphioxus, 44.
 Amyzon Tertiary beds, 332.
 Anchisodon, 279.
 Anchitherium, 462.
 Aniella pulchra, 782.
 Animal music, 209.
 Animals, domestic, origin of, 747.
 Annelida, 385.
 Anodonta californiensis, 145.
 Anoplopoma fimbria, 300.
 Ant, agricultural, 314.
 gall inhabiting, 126.
 slave making, 707.
 Ants, habits of, 525.
 mandibles of, worn by use, 596.
 Anthropology, 48, 129.
 Apes, anthropoid, anatomy of, 394.
 Aphenogaster, 708.
 Apple worm, 523.
 Archæopteryx, 727.
 Arctic expedition, Swedish, 132.
 Arctotherium simus, 791, 800.
 Arena sterilis, 419.
 Artemia fertilis, food of, 701.
 Aspidium boottii, 186.
 Axes, iron, 528.
 Bacteria, 601.
 luminous, 599.
 Bahna basin, 462.
 Bailey, W. W., on humble bees and Gerardia, 649.
 Balenoptera, 715.
 Ballou, W. H., does the snowy owl breed in the United States? 525.
 Barbeck, W., on fungi infesting cereals, 612.
 Barber, E. A., on Indian graves in Pennsylvania, 294.
 Barley grass, 418.
 Barnacle living on a gar pike, 453.
 Barnes, G. W., on sand mounds in California, 565.
 Barley, origin of, 751.
 Barracuda, 303.
 Bathybius, 715.
 Batrachians, effect of dry and moist heat on, 395.
 Beaumont, S. W., on twining of hedge bind-weed, 778.
 Bee gathering honey from Catalpa, 648.
 Bees, humble, and Gerardia, 649.
 Bee moth, 262.
 Belostoma, 710.
 Bennett, A. W., on absorption of water by leaves of plants, 20.
 Bilateral symmetry, 41.
 Birds, grease on plumage of, 456.
 music of, 209.
 Bitumen of Trinidad, 229.
 Blood corpuscles, human, nucleated, 137.
 Boll, J., geology and agriculture of Texas, 375.
 Boëtharchus humerosus, 131.
 Bosmina longirostris, 623.
 Botanical nomenclature, 184.
 Botany, history of American, 754.
 Bothriophthalmus latus in America, 410.
 Brain, human, variation of, 458.
 Brauds, 615.
 Brasenia peltata, 254.
 Brassica nigra, 413.
 Brazilian artificial mounds, 224.
 corals and coral reefs, 539.
 sandstone reefs, 347.
 Brendel, F., on intelligence in Canthons, 655.
 Historical sketch of N. A. Botany, 1035-1840, 754.
 on nomenclature, 184.
 on taking census of plants in a given area, 700.
 Brosmophycis marginatus, 306.
 Brown, A. E., grief in the chimpanzee, 173.
 Bubo virginianus, 783.
 Bufo dipterurus, 437.
 Cabbage worm, imported, 393.
 Caddis fly with branchiae, 586.
 California, ethnology of Southern, 327.
 fishes of, 299.
 sand mounds in, 565.
 Callidium variabile, 262.
 Call, P. E., on synonymous Unios, 392.
 Calystegia sepium, 778.
 Camarasaurus leptodirus, 403.
 Camels, breeding in Yuma, 470.
 Camptolæmus labradorius, 128.
 Candle fish, 300.
 Canthons, 654.
 Cardinal flower, 427.
 Caribou, protective coloration of, 140.
 Carnivora, teeth of, 171.
 Carpopaps pomonella, 523.
 Caton, J. D., on red squirrels, 46.
 on saw fish, 654.
 Catskills, topography of, 473, 799.
 Cave in Utah, 460.
 Cecidomyia trifolii, 190.
 Cells, lead, 409.
 Cels, turtle back, 128.
 Centipede, poisonous, 527.
 Centrosoma, fertilization of, 688.
 Cereal fungi infesting, 612.
 Cermæ a forceps, 527, 711.
 Cervus canadensis, 708.
 macrotis, 435.
 Champlain Valley, Archæology of, 731.
 Characeæ, American, 391.
 Cheat vs. wheat, 412.
 Chelopus marmoratus, 780.
 Chimæra, 685.
 Chimpanzee, 173.
 brain of, 410.
 Chirocephalus holmanii, 703.
 Chirotes, 782.
 Chirus constellatus, 301.
 gullatus, 301.
 Chorophilus triseriatus, 437.
 Citrus pomona, 647.
 Clark, F. C., on instinct and reason, 96.
 Clark, H. J., on Lucernaria, 692.
 Clark, Xenos, on animal music, 209.
 Clematis verticillaris, 537.
 Cliona, 279.
 Clitoria, fertilization of, 688.
 Cluster cups, 467.
 Cod, cape, formation of, 489, 552.
 green rack, 300.
 Codfish of the Pacific coast, 685.
 Cocilia, 787.
 Creolodon, 279, 592.
 Color, adjectives of, in Indian languages, 475.
 Colorado desert, fossil shells from, 141.
 plants, 675.
 Compressorium, Wenham, 138.
 Cook, A. J., on Lecanium of tulip tree, 324.
 on parthenogenesis in honey bee, 393.
 Cope, E. D., on Anchisodon, 279.
 on Aceratheria, 333.
 on Californian cave bear, 791, 800.
 on California gray whale, 655.
 on extinct mammalia of Oregon, 131.
 on fishes of Klamath lake, 784.
 on Japanese lap dog, 655.
 on Lota maculosa, 457.

- Cope, E. D., on New Jurassic Dinosaurians, 402.
 on Siredon, 456.
 origin of the specialized teeth of Carnivora, 171.
 on fossil mammals, 197.
 on the lower jaw of *Loxolophodon*, 334.
 on the necks of the *Sauropterygia*, 132.
 on a sting ray from the Green river shales of Wyoming, 333.
 zoology of Montana, 432.
- Copper implements, Indian, 460, 528.
 Corals and coral reefs, Brazilian, 539.
 Cotton worm moth, 726.
- Coues, E., on Colorado birds, 311.
 on the English sparrow, 706.
 on hairy-tailed mole, 189.
 on the nomenclature of *Hesperomys americanus*, 784.
- Cragin, F. W., on oviparous snakes, 710.
- Crane's bill, 413.
- Cranimetry, 130.
- Craniums, study of, 457.
- Crickets, sound producing organs of, 322.
- Crosby W. O., on pitch lake of Trinidad, 229.
- Crustacea, 45, 127, 514, 575, 584, 585, 599.
 classification of, new, 785.
 geographical distribution of, 575, 584.
 nebuliad, 128.
 stalk-eyed, 514.
- Ctenophora, 652.
- Cucumber, wild, 779.
- Cyclops, 622.
- Dace, breeding habits of, 321.
- Davenport, G. E., an *Aspidium bootii*, 186.
- Davenport herbarium, 390.
- Deer, one-toed, 738.
- Derby, O. A., on Brazilian artificial mounds, 224.
- Dercum, F., on morphology of semicircular canals, 266.
- Diamonds, in China, 471.
- Diaptomus longicornis*, 622.
- Dinosauria, Jurassic, new, 402.
- Dog, Japanese lap, 655.
 new forms of, 530.
 origin of, 748.
- Echinocystis lobata*, 779.
- Eel, discovery of male, 25, 125, 319.
- Elrod, M. L., on seeds as projectiles, 95.
- Enhydrocyon basilatus*, 131.
stenocephalus, 131.
- Entomological Commission, 60, 535.
- Entomostraca, fresh water, 620.
- Eozoon, 197, 270, 715.
- Ergot, 612.
- Ericomi*, 397.
- Erodium cicutarium*, 413.
moschatum, 413.
- Fucyrtidium cranoides*, 62.
- Euryptaurus spinosus*, 603, 703.
- Evolution, 725.
- Fairy ring, 256.
- Farlow, W. G., on sea weeds of Great Salt Lake, 701.
- Filaree, 413.
- Filaria sanguinis-hominis*, 410.
- Fish Commission, 61.
- Fishes, new deep sea, 455.
 sounds of, 586.
 of California, 299.
 Klamath lake, 784.
 soft rays of 41.
- Flax, origin of, 751.
- Flora, North American, 155.
- Flora of Mongolia, 521.
- Flowers, cross fertilization of, 1, 39, 40.
 dichogamy in, 39.
 fertilization of, by insects, 451.
 insects as unconscious selectors of, 257.
 nectar of, 124.
- Ford, J., on the leather turtle, 633.
- Forests and rainfall, 391.
- Formica, fusca, 707.
 sanguinea, 707.
- Formica, schaufussi, 707.
- Fox snake, does it mimic the rattlesnake? 582.
- Fraser, P., Jr., on the mesozoic sandstone of the Atlantic slope, 284.
 on protoplasm, 420.
- Frey, S. L., on mound-builders (?) in New York, 637.
- Fungi infesting cereals, 612.
- Gadus aurasus*, 685.
macrocephalus, 685.
- Gall inhabiting ant, 126.
- Gatschet, A. S., on adjectives of color in Indian languages, 475.
- Gemmule, 12.
- Generation, spontaneous, 139.
- Genyanemus lineatus*, 303.
- Geological Museum of Columbia College, 502.
 Surveys. U. S., 181, 343, 535, 727.
 time, series of animal forms in, 445.
- Geology of Cape Cod, 489, 552.
- Geraniums* in California, 415.
- Germ theory of disease, 595, 600.
- Gillman, H., on *Citrus pomona*, 647.
 on double flowers of *Houstonia*, 700.
- Gladiolus*, 4.
- Goat origin of, 750.
- Goose, age of, 62.
- Gordius*, 538.
- Grape fruit, 647.
- Grass, barley, 418.
- Gray, Asa, notice of Clark's *Instinct and Reason*, 317.
- Gregg, W. H., on the habits of dace, 321.
- Gryptonotum darwini*, 590.
- Guatemalan sculptures, 191.
- Hair, 50.
 Hair in negroes, insertion of, 397.
- Haldeman, S. S., note on animal music, 454.
 on double headed snakes, 525.
 on iron axes, 528.
 on asymmetric arrow-heads, 292.
- Haplocerus montanus*, 435.
- Hartt, C. F., on manufacture of pottery among savages, 78.
 on Brazilian sandstone reefs, 347.
- Hedge bindweed, 778.
- Helminthology, American, 386.
- Heloderma suspectum*, 781.
- Herrick, C. L., on fresh-water Entomostraca, 620.
- Hesperomys americanus*, 784.
- Heterodon platyrhinos*, oviparous, 710.
- Hill, E. J., on number of stamens in *Brasenia peltata*, 254.
 on *Potamogeton niagarensis*, 699.
 on *Shepherdia*, 699.
 on *Prunus pumila*, 649.
- Hoffman, W. J., discovery of turtle-back celts in Dist. of Columbia, 108.
 on aboriginal customs, 6.
 on molting of horned toad, 326.
- Honey bee, parthenogenesis of, 260, 393.
- Hooker, J. D., on the distribution of the North American flora, 155.
- Hoplophonus*, 197.
- Hordeum maritimum*, 418.
- Hornaday, on habits of orang, 712.
- Horse, origin of domestic, 750.
- Houstonia rotundifolia* with double flowers, 700.
- Hummer's meal, 127.
- Hydrocarbon in New Jersey, 198.
- Hydrolagus collii*, 685.
- Hypomesus olidus*, 307.
- Hypsiprophus seeleyanus*, 404.
- India, extinct reptiles of, 532.
- Indian arrow-heads, 292.
 manufacture of, 657.
 customs, 6.
 graves in Pennsylvania, 294.
 implements, 715.
 languages, adjectives of color in, 475.
 lost race of, 9.
 vocabulary, 787.
- Infusions, Tyndall on, 130.

- Infusoria, 711.
 Insects, 33, 34.
 brain of, 711, 730.
 as unconscious selectors of flowers, 257.
 food, 341.
 fossil, 132, 203.
 mimicing seeds and fruits, 703.
 powder, 572.
 Instinct and reason, 96.
 Japan, Crustacea of, 575.
 Jilison, B. C., on a fairy ring, 256.
 Jurassic Dinosauria, 402.
 King, F. H., mimicry of the rattlesnake by the
 fox snake, 582.
 Kingsley, J. S., on breeding habits of eel, 319.
 notices of works on Crustacea,
 45, 127, 514, 575, 584, 599.
 Leaves, absorption of water by, 20, 188.
 Lecanium of tulip tree, 324.
 Lee, L. A., on a cave in Utah, 460.
 Lepidosteus otariius, 441.
 productus, 441.
 Lichens, 206.
 Lilies of North America, 701.
 Limulus, fossil, 587.
 Lindahl, J., on tongue of woodpecker, 43.
 Lingula, 44, 387.
 Lintner, J. A., on clover seed fly, 190.
 Liodon, scales of, 132.
 Lithology, 385.
 Lobelia, fertilization of, 427.
 Lockington, W. N., on Californian fishes, 299, 684.
 on Pacific coast mammals,
 708.
 on Pacific coast reptiles and
 batrachians, 780.
 Lockwood, S. L., on the robin, 359.
 Locust, in old world, 600.
 Rocky mountain, in New Mexico, 586.
 Lophocentrus, 397.
 Lota maculosa, 439.
 Loxolophodon, lower jaw of, 334.
 Lucernaria, 692.
 Lucioperca borea, 439.
 Lum, S. K., on thrushes of Washington Terri-
 tory, 629.
 Lutricris (?) lycopotamicus, 131.
 Lycosa, habits of, 485.
 Lynx canadensis, 708.
 Macrurus bairdii, 455.
 Mammalia, extinct, of Oregon, 131.
 Mammals, fossil, 33.
 Gaudry on, 445.
 Man, pliocene, 799.
 Martindale, I. C., on Colorado plants, 675.
 Mason, O. T., on anthropology, 48, 129, 191, 265,
 338, 396, 457, 527, 656, 716, 787.
 Menzeia ornata, 779.
 Merycopater, 197.
 Mesozoic sandstone, 284.
 Micrometry, standard for, 337.
 Microscope, measurements with, 59.
 Microscopic specimens, removal of air from, 57.
 Millsbaugh, T. F., on twining of wild cucumber,
 779.
 Molar, third, 130.
 Mold as an insect destroyer, 681.
 Mole, hairy-tailed, 189.
 Montana, zoölogy of, 432.
 Mortillet, De, on origin of domestic animals, 747.
 Mound builders, 268.
 in New York? 637.
 not extinct, 459.
 Mounds, sand, in California, 565.
 Mugil, 305.
 Müller, H., on the mutual relations of flowers
 and the insects which cross them, 451.
 Music, animal, 209, 454.
 Mustard, 413.
 Myiarchus, 519.
 Mymar, 62.
 Myriopod, pauropod, 603.
 Myrtinia proboscidea, 2.
 Nebalia, 128.
 Negroes, hair of, 398.
 Neocarida, 786.
 New Zealand, 65.
 geological survey of, 330.
 Norway, mollusks of, 30.
 Oat, wild, 419.
 Ohio, archaeology of, 328.
 Olfactory centers, 717.
 Orang, habits of, 712.
 Ornithology of Texas, 261.
 Texan, 516.
 Osmerus thaleichthys, 307.
 Owl, 262, 783.
 snowy, 524.
 Ox, domestic, origin of, 750.
 Oxalis, seeds of, as projectiles, 95.
 violacea, root of, 521.
 Ozocerite, 197.
 Pacific coast fishes, 684.
 salmon, 522.
 Packard, A. S., Jr., on Cermatia forceps, 527,
 711.
 on male eel, 25, 125, 310.
 on nebuliad Crustacea, 128.
 on a new classification of
 the Crustacea, 785.
 on Rocky mountain locust
 in New Mexico, 586.
 on sea weeds of Great Salt
 lake, 701.
 Palæocarida, 786.
 Pangenesis, 14.
 Parthenogenesis in honey bee, 260, 393.
 Passer domesticus, 708, 706.
 Patton, W. H., on a gall-inhabiting ant, 126.
 Paurepus, 611.
 Pentstemon, 2.
 Pericome caudata, 680.
 Perkins, G. A., on archaeology of the Champlain
 valley, 731.
 Permian vertebrata, 332.
 Phosphorescence in marine animals, 599.
 Phoxinus milnerianus, 440.
 Phrynosoma douglassii, 526, 435.
 Phyllocarida, 128.
 Physa humerosa, 142.
 Physarum cinereum, 257.
 Phytoptus, 794.
 Picus, 43.
 Pig, origin of, 750.
 Pierce, N. B., on sound-producing organs of
 cricket, 322.
 Pityophis, 711.
 Plants, absorption of water by leaves of, 20.
 of Colorado, 675.
 cultivated, origin of, 751.
 dimorphic, 40.
 living, received by mail, how to treat, 650.
 self-fertilization of, 319.
 sensitive, contraction of leaves of, 319.
 taking of census of, in a given area, 701.
 Plastidule, 12.
 Podiceps dominicus, 518.
 Poelbrotherium sternbergii, 131.
 Polycystis packardii, 702.
 Polyps, swimming, 653.
 Pompino, 304.
 Potamogeton niagarensis, 699.
 Pottery of savage races, 78.
 Potts, E., on shedding of tracheæ, 454.
 on two chrysalids in one cocoon, 455.
 Pristis, 262, 654.
 Protolabis transmontanus, 131.
 Protoplasm, 12, 420.
 Prunus pusilla, 649.
 Rachianectes, 655.
 Rainfall and forests, 39.
 Rana berlandieri, 395, 436.
 halecina, 436.
 pretiosa, 435.
 temporaria, 780.
 Rathbun, R., on Brazilian corals and coral reefs,
 539.
 Prof. C. F. Hartt on the Brazilian
 sandstone reefs, 547.

- Rattlesnake, 322, 435.
 Read, M. C., on English sparrow, 190, 705.
 Redding, B. B., manufacture of Indian arrow-heads, 667.
 Rhinichthys atronasmus, 321.
 Rhinoceroses, fossil, 333.
 Rhizoclonium, 703.
 Rhododendron catawbiense, 777.
 Rhyolite, 401.
 Riley, C. V., on apple worms, 523.
 on shedding of tracheæ of insects, 652.
 Roberts, T. S., on the root of oxalis, 521.
 Robin, 359.
 Rocks, tertiary eruptive, 399.
 Wadsworth on classification of, 531.
 Rogers, W. A., on the limits of accuracy in measurements with the microscope, 59.
 Ruling, micrometric, 535.
 Russell, I. C., on fertilization of Wistaria, 648.
 on geological museum of Columbia College, 502.
 on New Zealand, 65.
 Rust, 615.
 Ryder, J. A., on boring sponge, 279.
 on Chirocephalus and Streptocephalus, 703.
 on Phytopus, 704.
 on Eurypterus, 603.
 on the gemmule vs. the plastidule as the ultimate physical unit of living matter, 12.
 on habits of barnacle, 453.
 on habits of bee, 648.
 origin of bilateral symmetry in fishes, 41.
 Rye, origin of, 751.
 Salix flavescens, 681.
 Salmon, breeding of land locked, 583.
 Pacific coast, 522.
 Salt lake, Great, sea weeds of, 701.
 Sarda lineolata, 303.
 Saunders, W., on insect powder, 572.
 Sauranodon, 271.
 Saurpterygia, 132.
 Saw fish, 262, 654.
 Scalops breweri, 189.
 Scaphirhynchops platyrhynchus, 439.
 Sciurus hudsonius, 46.
 Scomber colias, 304.
 Scorpaenichthys marmoratus, 301.
 Sea-weeds fertilized by infusoria, 711.
 of Great Salt lake, 701.
 Sebastes, 301, 302.
 Seeds and fruits, mimicry of, by insects, 703.
 dispersion of, 698.
 form of, as a factor in natural selection, 411.
 hygroscopic, 417.
 Shells, fossil, from Colorado desert, 141.
 Shepherdia canadensis, 699.
 Sheep, domestic, origin of, 751.
 Streptocephalus seali, 703.
 Sida crystallina, 623.
 Siewers, C. G., on mold as an insect destroyer, 681.
 Simonds, F. W., on Rhododendron catawbiense, 778.
 Sireons, Mexican, 456.
 Skeleton, human, 457.
 Skulls, human, 717.
 perforated, 327.
 as cinerary urns, 328.
 Sloth, 315.
 Sloths, giant fossil, 590.
 Smelt, Californian, 306.
 Smith, F. S., spawning of the spade-foot toad, 652.
 Smut, 614.
 Snake, double-headed, 525.
 mimicry in, 711.
 vibrations in tail of, 712.
 Snakes, oviparous, 710.
 Snowy owl, 524.
 Sounds made by fishes, 587.
 Sparrow, English, 190, 705, 706.
 Spea bombyrons, 436.
 Sperophilus richardsoni, 709.
 Sphagnum coriaceum, 467, 633.
 Sphyræna argentea, 303.
 Sponge, boring, 279.
 Squilla, a fossil, 587.
 Squirrel, red, 46.
 Stearns, R. E. C., on fossil shells from the Colorado desert, 141.
 on seeds as a factor in natural selection, 411.
 Stenamma gallarum, 126.
 Stevens, A. H., on prevention of grease from injuring plumage of birds, 456.
 Sting ray, tertiary, 333.
 Stromateus simillimus, 304.
 Sturtevant, E. L., on salmon, 583.
 Stylasteridæ, 121.
 Swallow, 706.
 Swigert, S. M., on habits of Sperophilus richardsoni, 709.
 Symplocarpus fœtidus, fertilization of, 589.
 Szabó, J., on tertiary eruptive rocks, 399.
 Tarantula, habits of, 485.
 Taylor, J. R., on the English sparrow, 706.
 Teeth, genesis of, Ryder on, 446.
 of Carnivora, 171.
 Tertiary eruptive rocks, 399.
 Texan ornithology, 516.
 Texas, birds of, 261.
 geology of, 375.
 Thrushes of Washington Territory, 629.
 Toad, horned, molting of, 336.
 spade-foot, 651.
 Todd, J. E., on cross-fertilization of flowers, 1.
 on the growth of trees, 123.
 Tooth, third molar, 130.
 Tracheæ, shedding of, in molting of insects, 454.
 652.
 Trachyte, 401.
 Treat, M., on slave-making ants, 707.
 on the tarantula, 485.
 Tree, growth of, 123.
 Trelease, W., on the fertilization of Clitoria and Centrosema, 688.
 on fertilization of several species of Lobelia, 427.
 on fertilization of Symplocarpus fœtidus, 580.
 review of Muller on cross-fertilization of flowers by insects, 452.
 Tricrania stanchurii, 45.
 Trilobites, development of, 659.
 Trinidad, pitch lake of, 229.
 Trochifera, 387.
 Tryonia protea, 142.
 Turdus, 629.
 Turner, H., on Belostoma, 710.
 on a stratagem of a wasp, 710.
 Turtle, leather, 633.
 Ulva marginata, 702.
 Unio, 392.
 Upham, W., on geology of Cape Cod, 489, 552.
 Utah, cave in, 460.
 Vertebrata, evolution of, 725.
 Viola, seeds of as projectiles, 94.
 Violet, seeds of as projectiles, 93.
 Voegles, A. W., on a lost race of America, 9.
 Volcanoes in California, 602.
 Wasp, 710.
 Wax, mineral, in Utah, 197.
 Whale, 715.
 gray, 655.
 Wheat, origin of, 747.
 Wistaria, fertilization of, 648.
 Woodpecker, red-headed, habits of, 522.
 tongue of, 43.
 Worms, intestinal, 386.
 turbellarian, 314.
 Wren, 262.
 Xantusia riversiana, 801.
 Xiphotrygon acutidens, 333.

